computing today

MAY 1980
ISSN 0142-[illegible]
60p

STOCKMARKET!
Get rich quick...

COSTLY CARS?
More miles per pound

COMPUTER PATTERNS

BUZZWORD CHART

TAPE INTERFACE

LATEST SEIKO CALCULATOR WATCH
Over 30% off RRP. See inside...

8K ON BOARD MEMORY!
5K RAM, 3K ROM or 4K RAM, 4K ROM (link selectable). Kit supplied with 3K RAM, 3K ROM. System expandable for up to 32K memory.

2 KEYBOARDS!
56 Key alphanumeric keyboard for entering high level language plus 16 key Hex pad for easy entry of machine code.

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64 character graphics option — includes transistor symbols! Only £18.20 extra!

MEMORY MAPPED
high resolution VDU circuitry using discrete TTL for extra flexibility. Has its own 2K memory to give 32 lines for 64 characters.

KANSAS CITY
low error rate tape interface

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Increased capacity at our Big New Factory means many prices down! All others frozen!

Cabinet size 19.0" x 15.7" x 3.3". Television not included in price.

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Z80 the powerful CPU with 158 instruction, including all 78 of the 8080, controls the MM57109 number cruncher. Functions include +, −, *, /, squares, roots, logs, exponentials, trig functions, inverses etc. Range 10^{-99} to 9×19^{99} to 8 figures plus 2 exponent digits.

EFFICIENT OPERATION
Why waste valuable memory on sub routines for numeric processing? The number cruncher handles everything internally!

RESIDENT BASIC
with extended mathematical capability. Only 2K memory used but more powerful than most 8K Basics!

1K MONITOR
resident in EPROM.

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Even keyboards and power supply circuitry on the superb quality double sided plated through-hole PCB.

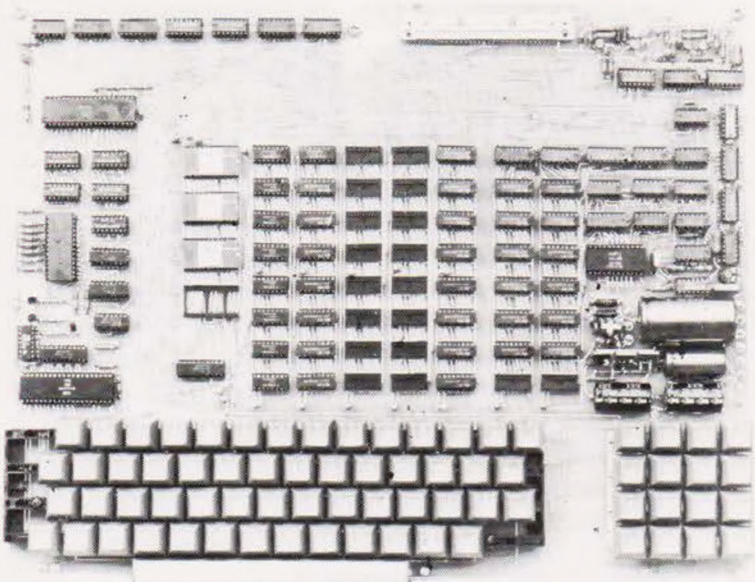
COMPLETE KIT NOW ONLY £225 plus VAT!

POWERTRAN

PSI Comp 80.Z80 Based powerful scientific computer Design as published in Wireless World

The kit for this outstandingly practical design by John Adams published in a series of articles in Wireless World really is complete!

Included in the PSI COMP 80 scientific computer kit is a professionally finished cabinet, fibre-glass double sided, plated-through-hole printed circuit board, 2 keyboards PCB mounted for ease of construction, IC sockets, high reliability metal oxide resistors, power supply using custom designed toroidal transformer, 2K Basic and 1K monitor in EPROMS and, of course, wire, nuts, bolts, etc.



KIT ALSO AVAILABLE AS SEPARATE PACKS
For those customers who wish to spread their purchase or build a personalised system the kit is available as separate packs eg. PCB (16" x 12.5") **£43.20.** Pair of keyboards **£34.80.** Firmware in EPROMS **£30.00.** Toroidal transformer and power supply components **£17.60.** Cabinet (very rugged, made from steel, really beautifully finished) **£26.50.** P.S. Will greatly enhance any other single board computer including OHIO SUPERBOARD for which it can be readily modified. Other packs listed in our FREE CATALOGUE.

PSI COMP 80 Memory Expansion System
Expansion up to 32K all inside the computer's own cabinet!

By carefully thought out engineering a mother board with buffers and its own power supply (powered by the computers transformer) enables up to 3 8K RAM or 8K ROM boards to be fitted neatly inside the computer cabinet. Connections to the mother board from the main board expansion socket is made via a ribbon cable.

Mother Board	Fibre glass double sided plated through hole P.C.B. 8.7" x 3.0" set of all components including all brackets, fixing parts and ribbon cable with socket to connect to expansion plug	£39.90
8K Static RAM Board	Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8"	£12.50
	Set of components including IC sockets, plug and socket but excluding RAMs.	£11.20
	2114L RAM (16 required)	£5.00
	Complete set of board, components, 16 RAMS	£89.50
8K ROM Board	Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8"	£12.40
	Set of components including IC sockets, plug and socket but excluding ROMs	£10.70
	2708 ROM (8 required)	£8.00
	Complete set of board, components, 8 ROMs	£78.50

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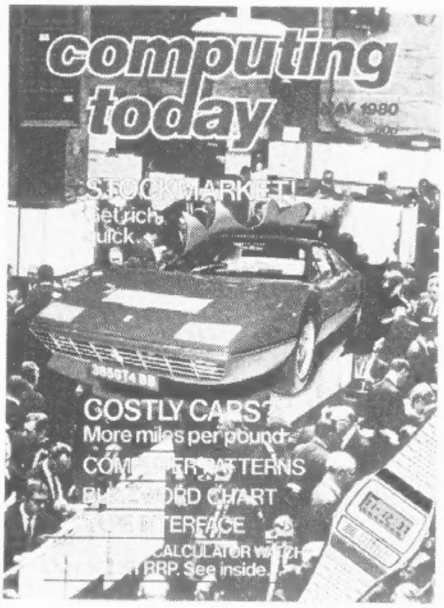
computing today

VOL.2 No.3
MAY 1980



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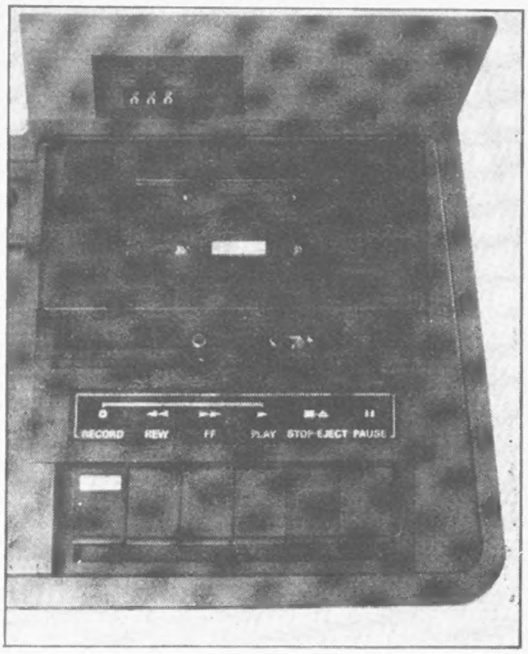
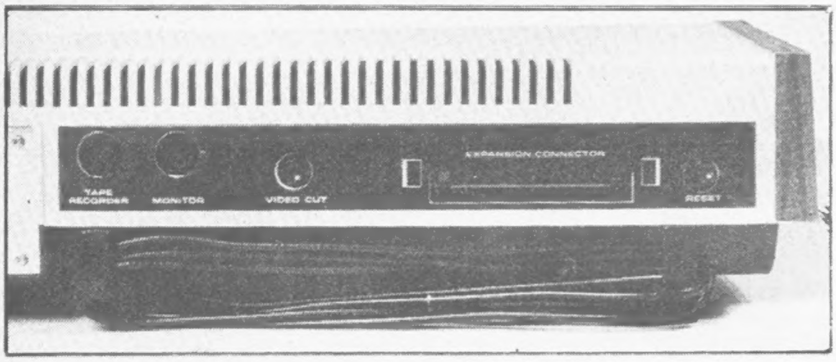
WHAT DOES £425 (incl VAT) BUY IN 1980 ?

A highly quality cassette, with tape counter 16k user RAM. A full 12k Microsoft compatible BASIC, and system monitor, which is able to run TRS-80 level II programs straight from cassette tapes.

A bounce free typewriter keyboard. A stylish case containing a cassette, PSU, and UHF modulator.

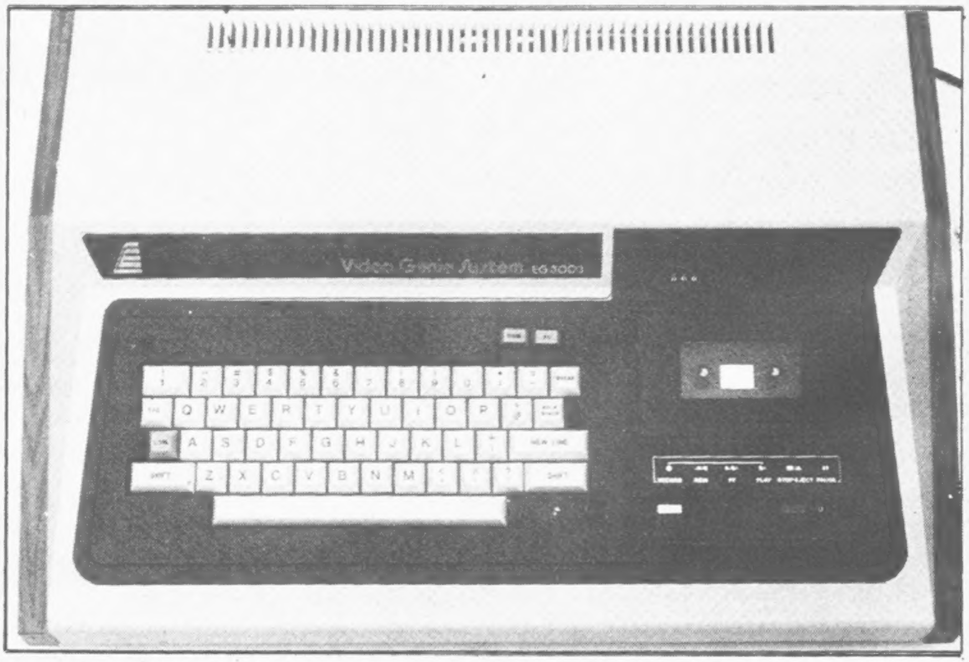




With full expansion capability, also outputs for, video, TV and second cassette.

In short a:–

video genie system

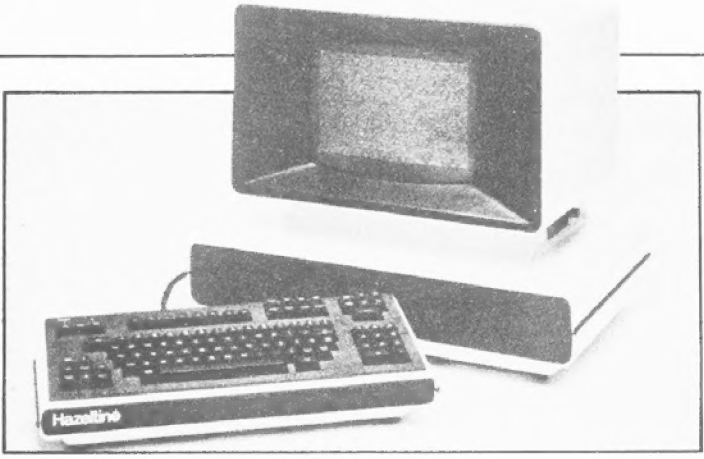


Contact:—

LOWE ELECTRONICS

Lowe Electronics Limited, Bentley Bridge, Chesterfield Road, Matlock, Derbyshire. DE4 5LE. Telephone 0629 2817 or 2430. Telex 377482 LOWLEC G

TRADE ENQUIRIES WELCOME



VDU SELL OFF

Electronic Brokers have a special purchase of Hazeltine VDUs that they are selling off at less than half price. Although they are second hand they are "refurbished as new" and offered with full warranty and back-up. There are two versions available, a basic model at £425 and an editing version for £695. Both prices do not include VAT or carriage. Contact Electronic Brokers at 49–53 Pancras Road, London NW1X 4QL.

REM FOR PILOTS

Those of you who are delving into our Distance program, published in the Feb issue, may have come across an anomoly in the formulae. In the polynomial expression that we published for arc cos the third term in the bracket should have read

$$\frac{1*3*5}{2*4*6*7},x^7$$

There are no errors in the actual program listing that we are aware of.

BUMPER BOOKLET

Petsoft, that most prolific of software publishers, has expanded its new catalogue to 16 pages in order to cram all the goodies in. Among the new products is a hand-held digitiser pad called Prestodigitiser and the range of programs that we have been covering in our news recently. Not only are software and hardware from Petsoft included but also the vast range of other people such as Hippo-soft and Personal Software are all mentioned. Free copies of the catalogue are available direct from Petsoft at their Birmingham address as is all the software on mail order. The rate of growth of the ACT group of which Petsoft is a member has caused them to open a new Engineering and Research centre in Birmingham which will be used to test and maintain the new Series 800 systems produced in conjunction with Compu/Think. I mentioned some months ago that a gold cassette had been presented to an author of one of Petsoft's programs for reaching the 50,000th sale, well the Americans in the form of Personal Software seem to have felt left out and are now busily throwing gold plated objects around like confetti. Britain 1, USA 0.

ZAKS BACK

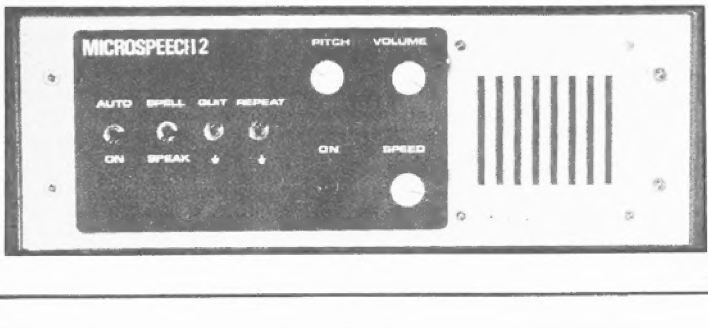
Rodney Zaks, the man of many words, has moved to new territory with a book on the Z80. Does this mean the 6502 is dead? From the press release — we haven't got a review copy yet — it sounds as if the book is in a similar format to his offerings on the 6502 and hopefully it won't have as many mistakes. Titled "Programming the Z80" it is obtainable from Sybex who reside at 18 Rue Planchat, F–75020, Paris and contains 625 pages. They also forgot to tell us how much it costs but your local friendly bookshop should be able to help. Sybex's UK distributor is the Computer Bookshop, Temple House, 43–48 New Street, Birmingham, B2 4LH.

SPEAK TO ME

Details of the Mk 2 version of Microspeech thudded onto my desk last week. The veritable tome was accompanied by a brief description which I shall quote verbatim.

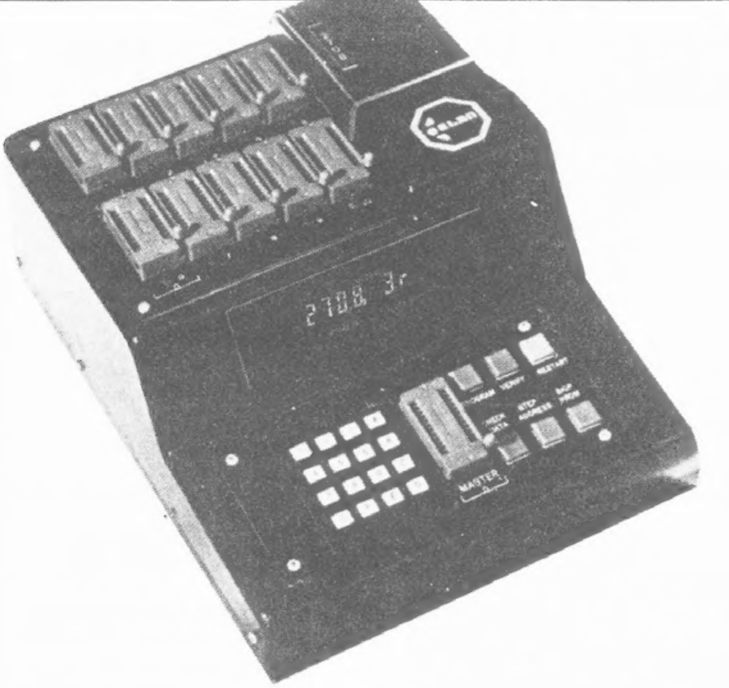
MICROSPEECH 2 is a stand alone speech synthesizing unit. It converts phonetic code or any text (which is input via a standard RS232 connection) into a speech output. MICROSPEECH 2 may be interfaced to any computer system because all the computation necessary to synthesize speech is performed by its own dedicated microprocessor. In fact it is possible to run the unit from just an ASCII keyboard. Up to one thousand phonetic characters, representing about one minute of speech, may be assembled in the units internal buffer before it is commanded to speak. The controlling microprocessor has a spare ROM capability of 4K bytes which can be used to store an optional text to phonetics translator program. This includes the phonetic equivalents of all the standard ASCII symbols, and thus enables the unit to be driven directly from English text. Although the speech in this mode is not always as good as that produced in the phonetic mode, it does allow many common messages to be rapidly programmed, and it also makes the unit extremely useful to the blind.

Costronics Electronics of 13 Pield Heath Avenue, Hillingdon, Middlesex.



REVISED BUSINESS

The ECC publications series of Computer Guides has had a facelift with the re-launch of the Guide To Small Business Systems in an updated form. The 1980 guide has expanded from 250 to 900 systems ranging between £1000 and £100,000 with vital information on who supplies what, names and addresses of contacts etc all updated. Anyone who is thinking of buying a business system should consider investing the £24 for the guide as it is a useful source. Copies can be obtained direct from ECC Publications, 30–31 Islington Green, London N1 8BJ.



INTELLIGENT PROGRAMMER

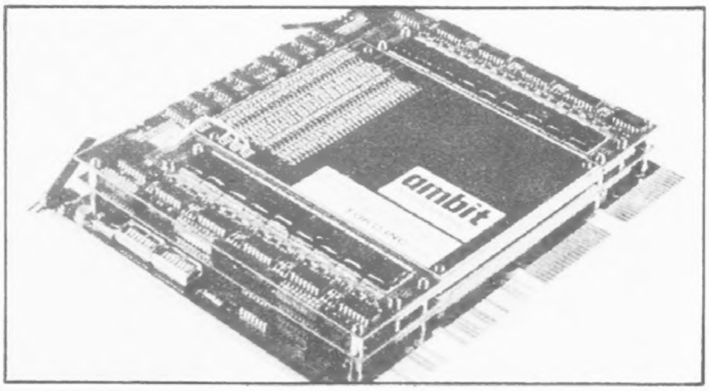
A new PROM programmer and verifier unit has been announced by Elan Digital Systems. Called the P30 it features a degree of intelligence not previously associated with "blowing" and seems to be a useful piece of kit. It is capable of gang programming up to 20 EPROMs and it can accept all current EPROMs between 4 and 32K. It even tells you which type it expects when you turn it on. As well as all the usual data entry facilities it also has a fault verification and data manipulation-editing facility as well so you can alter the contents of the master before copying. Options are available to input data from tape or serial ports rather than a master PROM. For more detailed information you should contact EDS at 16–20 Kelvin Way, Crawley, West Sussex RH10 2TS.

AMBITEXTROUS?

The well known mail order and distribution company, Ambit, have acquired a second arm-Ambyte. Headed by Jon Burchell they have among their newly launched range an interesting memory system. Known as plated wire it combines the best of most other systems in that it is non-volatile, it uses a single 5 V supply, it's expandable, it's fast (200–400 nS), you have a non-destructive read and you can have up to 2M by 9 in a single array. Sounds better and better doesn't it. Units are available for the Z80 bus and the LSI II series and doubtless more will appear soon. Toko – the manufacturer – reckon that the ideal environment is in DP and they are currently investigating more applications with Ambyte. Find out more direct from Ambyte at 200 North Service Road, Brentwood, Essex.

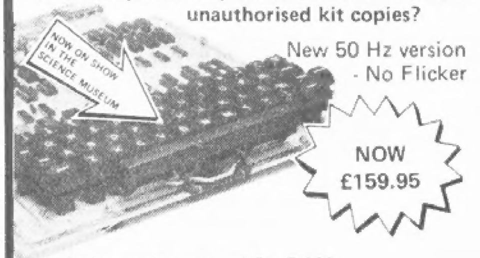
SYSTEM 80 = N2

NASCOM have now announced a complete range of boards to go with the "2" to make a complete system – System 80. The extended range has a moulded case as its starting point which will take a "2" plus keyboard and four other cards as well as a PSU. The cost of the case is £85 but "1" users will not be able to make use of it unless they are prepared to do a bit of hacking. Next on the stocks is a new RAM plane (thank goodness) which offers 16, 32 or 48K of dynamic with locatable boundaries, write protect and Page mode allowing up to four 48K boards to be used on a "2", price is £225. I/O is being catered for at last with a board containing 3 PIOs, a counter timer and a UART. This is supplied as a basic board with TTL and then you buy the I/O kits you need. Prices are £45 for the board and £8.50 for each PIO, £8.25 for the counter timer and £16 for the UART. Graphics capability is being enhanced with a programmable graphics generator board at £90 and a dual standard colour graphics board that has yet to be priced but will cater for any two required colour TV systems. And, last but by no means least, on the board front we have the floppy disc controller which will be able to handle up to four 5¼"s and probably 8" as well but the software support will be on 5¼"s. This board costs £127.50 and will be available in June. A full dual floppy system using double sided, double density Siemens drives will set you back £690.00. The second major news to come out of the launch was that the "2" will be sold at £225 as of March 1st but with no on-board RAM and no free RAM board so grab those special offers quickly. The idea is that the systems people will bung firmware into the 4118 sockets and rely on the new RAM planes. If you want on-board RAM it'll cost you about £100! I resisted all the obvious leaders for this news item line "Kerrless NASCOM Launch" etc but the news is that Kerr Borland has moved on from NASCOM to form his own company – Product Launch. Almost immediately he signed up NASCOM and is now promoting their product – namely System 80. Well it's goodbye and welcome back all in one sentence.



Superboard II -OHIO- Challenger 4P

At these prices why waste time and money on unauthorised kit copies?



New 50 Hz version - No Flicker

NOW £159.95

610 Expansion Board 8k RAM
ONLY £159.95 + VAT
IP CD3P Minifloppy Disc, Cased, PSU, 2 copies of DOS - ONLY £289 + VAT
Set of 4k RAM (Superboard users only)
ONLY £28 + VAT
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Discs & Cassettes available

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A major breakthrough in price/performance for personal/ business educational micro's
- Single RF O/P provides both sound & vision to colour TV. (Colour sets only).

NEW

**8k Microsoft 8k User RAM *16 colours, 32 rows x 64 cols. *Programmable tone generator and DAC *Joystick and keyboard interface.*

Challenger 4P - 8k Basic in ROM 8k RAM expandable to 32k - ONLY £475 + VAT
Challenger 4P MF - Same as 4P but with Mini-floppy 24k RAM, expandable to 48k - ONLY £1095 + VAT
Complete range of accessories available

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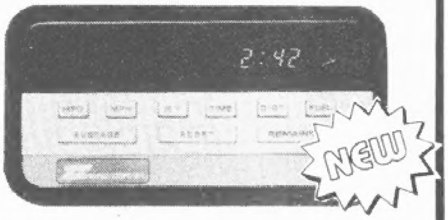
Add a new dimension to your car with cost effective fuel management.



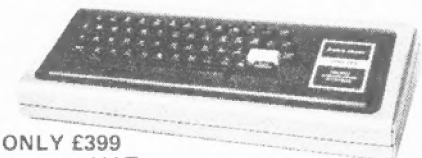
NEW

**MPH Instant *MPH average *Gals. used since fillup *Miles to empty *Elapsed time *Time to empty *Time on trip *Miles on trip*

Accuracy: Time ± 30 secs/month
Speed ± 0.5 mph Instant
± 0.005mph Average
Fuel used ± 3%

Takes about 2hrs to fit ONLY £77.50 +VAT

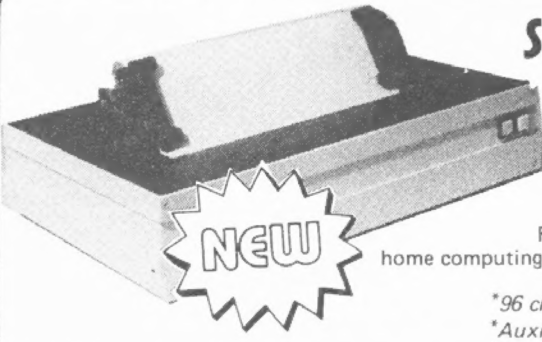
TRS80 LEVEL 2 16K



ONLY £399 + VAT

Keyboard, computer, power supply, UHF modulator and all cables to plug into your own TV set and cassette recorder and go ! 16K of user RAM for decent size programmes and data, sophisticated level II microsoft basic. Fully converted to UK standard.

Super Print 800



NEW

80 COLUMN HIGH PERFORMANCE IMPACT PRINTER

The ideal companion for PET, Apple, TRS80, Exidy, Superboard, Compukit and most Micro's

Rugged metal enclosure makes it ideal for home computing, small business systems, data logging etc.

Just look at these standard features:

**RS–232, 20mA, IEEE 488 and Centronics I/O*
**16 Baud Rates to 19,200*
**60 Lines per minute - Bidirectional*
**5 print densities 72,80,96,120 or 132 Chr/Line*
**Self Test Switch*
**96 character ASC II Standard*
**Auxilliary User Defined Character Set*
**Accepts 8½" max. paper - pressure feed 9½" max. paper - tractor feed*
**Tractor & Fast Paper Feed/Graphics (model ST)*

OPTION:-
**2k Terminal Buffer*

Standard Feed-Model 800
ONLY £329+VAT

Tractor & High Speed-Model 800ST
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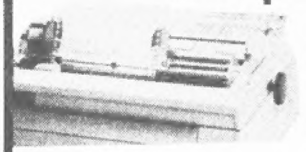
NEC Spinwriter



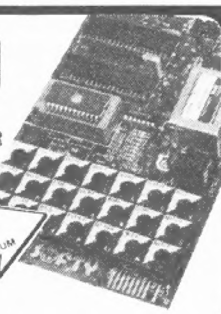
- for the professional word processing system

£1699 + VAT

NEC's high quality printer uses a print "thimble" that has less diam.and inertia than a daisy wheel.Giving a quieter, faster more reliable printer than can cope with plotting and printing(128 ASC II chs.) with up to 5 copies,friction or tractor fed.The ribbon and thimble can be changed in seconds. 55 chs.per sec. bidirectional printing-with red/black,bold,subscript, proportional spacing, tabbing, and much much more.

SOFTY

INTELLIGENT EPROM PROGRAMMER



Built or in Kit form
Connects directly to TV. Develop, Copy, Burn, Verify 2708, 2716 and with modification 2516.

Softy is a versatile product and each application will be different by definition. When Softy is connected via a serial (RS 232) or parallel link with any small computer capable of supporting an assembler a simple and capable Product Development System is formed. For product developments with less than 2k of firmware Softy may be the only development tool you will need.

**Fast cassette interface-over 2000 baud eqiv.*
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Current carts. include:- Air-Sea Battle, Space War, Outlaw, Video Olympics, Breakout, Basketball, Surround, Blackjack, Basic Maths, Hunt & Score, Miniature Golf, Skydiver, Street Racer, Chess, Backgammon and many more.

Cartridges mostly - £13 + VAT
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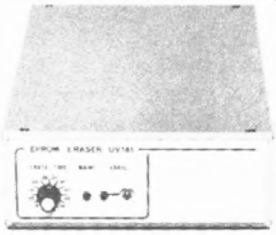
Coming Soon — BASIC Computing, Space Invaders plus many more !
Buy a VCS, introduce a friend to buy one and get a Keyboard FREE worth £19 (limited Ingersol Offer)
Atari VCS NOW ONLY £113 + VAT
+ your first cart. - £6.90 + VAT (worth £13)

GP MODEL 14

Eprom Eraser



ONLY £78 + VAT

**14 Eprom capacity *Unit safety interlocked to prevent accidental exposure *Erase time (Model UV141) adjustable 5 to 50 minutes in 5 minute steps *Fast erase times typically 20 mins for 2708 Eprom *UV source output at 2537 Angstroms*

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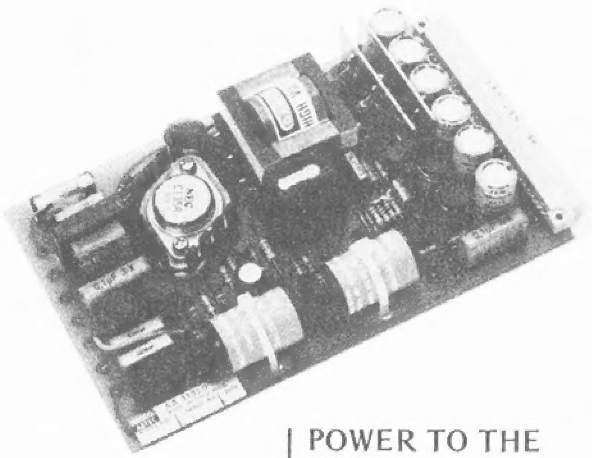


VERSATILE INTERFACE

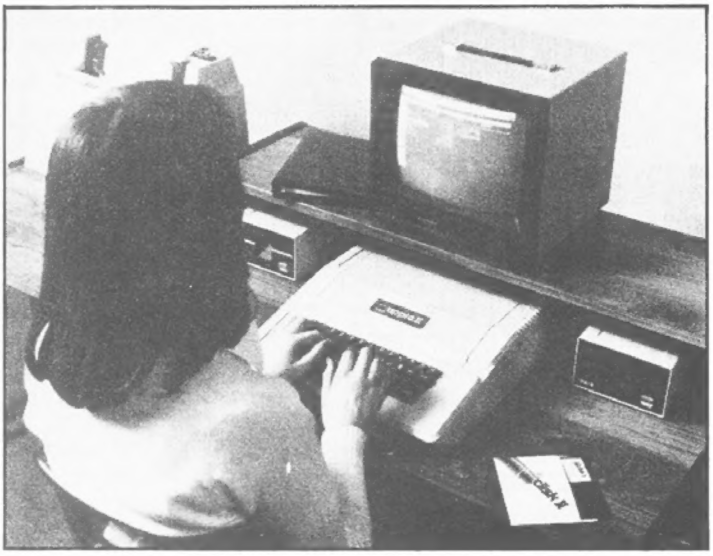
A new interface unit for the Commodore PET has been launched by Allen Computers of 16 Hainton Avenue, Grimsby, South Humberside. The system combines both hardware and software techniques and can be used on any model PET. Output can be in serial or parallel mode but input is serial only, formats are RS232, V24 and 20 mA at speeds of up to 240 cps. The machine code routine needed can be stored anywhere in RAM. Price of the unit is £70 plus VAT and includes post and packing.

POWER TO THE PEOPLE

Astec, the makers of modulators, have added two new items to their range in the shape of Eurocard size voltage regulators. Both use switch mode and have a number of features which make them suitable for MPU systems. The AA1135A supplies +5 at 3 A and +12 at 1.2 A, the B version has two floating 5 volt, 3 A supplies which can be connected in series or parallel if required. Prices start at £44.90 ex VAT for one-offs of either type and decrease to £35.40 with quantities over 100. If you think this is the supply you need then contact Astec at 4A Sheet Street, Windsor, Berkshire.

APPLE OK

The Prestel card that we mentioned last month for the Apple is one step nearer to PO approval after the Communications card — on which it is based — received approval for Datel 200 connection. Apple owners with this card may now connect to the various nationwide networks through a PO modem. The second offering from Microsense in a matter of weeks is Apple Writer, a word processing package. Requiring a system with disc and 48K of RAM, the software costs a mere £42 and is said to be capable of most simple text handling functions. Systems with printers will be able to get hard copy output but you can always pass the discs to a central printer. The software comes on two diskettes and a tutorial and operating manual is supplied. For more information on the whole range of Apple goodies contact Microsense Computers at Maxted Road, Maylands Avenue, Hemel Hempstead, Herts HP2 7LE.



AIMING TO EXPAND

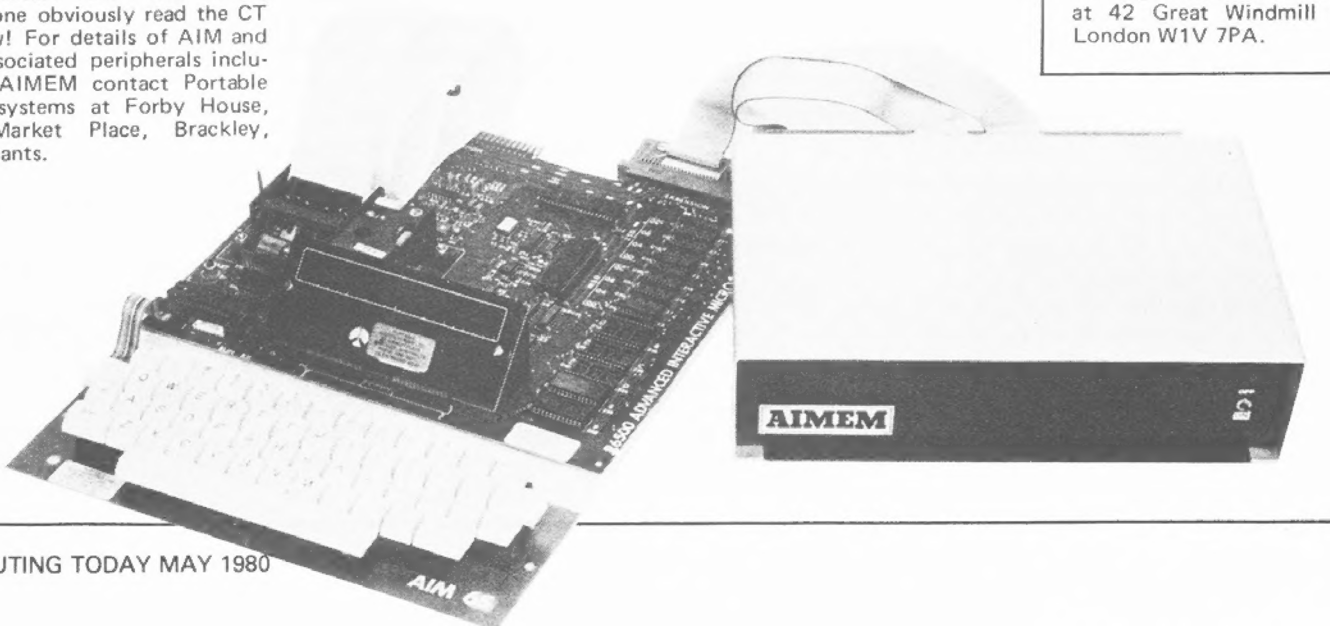
The AIM 65 single board computer can now be expanded to have an extra 32K of RAM in a free standing unit. Called AIMEM it has a built-in power supply and costs £335 plus VAT. Although it is intended for use on the AIM it should be possible to use it on any system based around the Motorola Exorciser bus system or its derivatives. Also rumoured to be coming for the AIM in the very near future is a VDU board, someone obviously read the CT review! For details of AIM and its associated peripherals including AIMEM contact Portable Microsystems at Forby House, 18 Market Place, Brackley, Northants.

BEGGING YOUR PARDON

Our highly popular program suite, The Fall Of Rome, has run into a problem. The program called Space Invaders actually runs on a Level 5.2 Triton but can be run on any Level of Triton with mods. The name "Space Invaders" is in fact the copyright of Taito Electronics Ltd and we apologise to them for its use without permission. We ran a news item last month on some shops that have been expanding recently and one of them was Midwich. No sooner had we put the address on the page than we received a note telling us that they have moved again! All enquiries about their range of Nanocomputer and other SGS Ates kit should go to 9 Churchgate Street, Old Harlow, Essex CM17 0JS. Their new telephone number is 0279-411226.

ALL THE FUN OF THE FAIR

All people who are young at heart should make a note of the following dates, July 3, 4 and 5. That is when this year's Young Computing Funfair takes place at the West Centre Hotel in London. After last year's success and the opening recently of the "Challenge of the Chip" exhibition it could well turn out to be a young persons Compec. Further information can be obtained directly from the organisers, Couchmead Ltd at 42 Great Windmill Street, London W1V 7PA.



COMPUTA-PATTERN

R.J. Fox.

Can the TRS-80 equal Picasso, do we really care? Have fun with this graphic example of the Trusty 80s flexibility.

To those who in days of yore, that's before central heating if you're young. . .were wont to stare dreamily into the flames, conjuring fabulous fairylands from amongst the glowing coals. . .or perhaps lay warm and snug abed as nymphs and demons smiled and sneered from heavy patterned walls. . .and even those whose bent it is to dream of fortune told by leaves left in the dregs. . .

I dedicate this computerised crystal ball that it may stimulate your imagination and bring visions of oriental palaces. . .Aladdin's Caves. . .temples. . .minarets. . .altars. . .dancers. . .demons. . .shamans. . .witch-doctors. . .and every conceivable pattern that man has tortuously devised since first he gained the faculty of wonder.

You will recognise Aztec. . .Mayan. . .Amer-Ind. . . Arabian. . .Siberian. . .Oriental. . .Polynesian. . .an infinite gamut (if I may use a contradiction in terms) of pattern, in this pageant of true computer originated art.

To conclude this eulogy may I express my very deepest regrets that those of you whose misfortune it is to own inferior machines such as PET, Apple, Sorcerer, etc., cannot share an experience we favoured TRS 80 level II users take so much for granted.

Observations

Joshing aside, there are few micros that could run this program using BASIC on a 30 x 30 format. . .the TRS could use 48 x 128, though the time would be rather inhibitive without resort to machine code.

Since writing same, I have found that the rather long wait for program interrupt to operate can be reduced to a near immediate response by altering tail end of line 90 to read. . .

```
NEXT Y:A$=INKEY$:IF A$="1" THEN 120 ELSE
NEXT X
```

This modification adds slightly less than 1 sec to pattern loop, and for the impatient may be preferred. I found the delay bearable as I used the time to ready the trusty cassette and sacrificed everything to maximum speed in pattern cycle.

Those that demean the TRS performance should note that if the padding were removed and pattern taping facility omitted, the whole program could be run in *seven* succinct lines by placing line 10 at beginning of line 50. Or, by relinquishing control of provocateur bars, *only five lines* would suffice, by joining line 10 to line 70 and ending at line 110.

So go to it, enter program, place video next to family TV and run (not from the family, as the TRS's dead silent).

```
10  CLEAR 2000:CLS:DEFINTX,Y,S,N,P,Q,I,J,K,G:X=
    39:Y=44:DIM S(X,Y),A$(30):I=7:P=26:Q=32
20  PRINT@452,CHR$(23)"–:– COMPUT=A=PATTERN
    –:–":FOR L=1 TO 3000:NEXT:CLS:PRINT"[2x
    SPC]SINCE THE DAWN OF INTELLIGENCE MAN
    HAS BEEN FASCINATED BY PATTERNS.[2xSPC]
    HERE IN ONE PACKAGE YOU WILL FIND
    EXAMPLES FROM MAYAN. .AZTEC. .AMER–IND.
    .SIBERIAN. .ORIENTAL. .";
30  PRINT"THE ENTIRE GAMUT OF MANKIND.[LF]
    ALLOW YOUR IMAGINATION TO ROAM IN THIS
    NIGH INFINITE SERIES AND YOU WILL SEE
    PALACES. .TEMPLES. .ALTARS. .MINARETS. .
    DEMONS. .DANCERS. .NYMPHS. .SHAMANS. .
    WITCH–DOCTORS. .AND PRINCES FROM";
40  PRINT" THE FAIRYLAND OF ARABIAN NIGHTS.
    [CR][2xSPC] EACH PATTERN WILL REMAIN ON
    SCREEN FOR 1 MIN. 12 SECS. *** TO HOLD,
    RECORD, OR PLAYBACK A PATTERN, PRESS
    KEY 'I' DURING OPERATION AND INSTRUC-
    TIONS WILL APPEAR AT TOP OF SCREEN.
50  INPUT" THE PATTERN PROVOKING BARS HAVE
    BEEN SET. . .BUT YOU MAY VARY THEIR
    POSITION BY ENTERING NUMBERS BETWEEN
    –10 AND +10 FOR FIRST RUN TRY ENTERING
    0,0 NOW";J,K:CLS:P=P+JIF P<16 OR P>43 P=26:
    GOTO 50
60  Q=Q+K:IF Q<16 OR Q>43 Q=32:GOTO 50
70  FOR X=9 TO 40:SET(X,14):SET(X,45):NEXT:FOR
    Y=14 TO 45:SET(9,Y):SET(40,Y):NEXT
80  IF I>5 I=0:FOR N=19 TO 30:SET(N,P):SET(N,Q):
    NEXT
90  FOR X=10 TO 39:FOR Y=15 TO 44:S(X,Y)=POINT
    (X–1,Y–1)+POINT(X–1,Y)+POINT(X–1,Y+1)+
    POINT(X,Y–1)+POINT(X,Y+1)+POINT(X+1,Y–1)+
    POINT(X+1,Y)+POINT(X+1,Y+1):NEXT Y,X:A$=
    INKEY$:IF A$="I" THEN 120
100 I=I+1:G=G+1:PRINT@0,"PATTERN. . . ."G"
    PROVOCATEUR BARS. . "J" & "K"[14xSPC]":FOR
    X=10 TO 39:FOR Y=15 TO 44:IF S(X,Y)>–2 OR
    S(X,Y)<–3 THEN RESET (X,Y) ELSE IF S(X,Y)=
    –3 SET(X,Y)
110 NEXT Y,X:GOTO 80
120 PRINT@0,"* HOLDING * PRESS A TO RESUME.
    * IS RECORDER READY. .? * PRESS P TO PLAY
    BACK. . R TO RECORD.
130 A$=INKEY$:IF A$="A" THEN 80 ELSE IF A$="R"
    THEN 140 ELSE IF A$="P" THEN 170 ELSE 130
140 FOR X=1 TO 30:FOR Y=15 TO 44;IF POINT (X+9,
    Y) THEN U=1 ELSE U=2
150 A$(X)=A$(X)+STR$(U):NEXT Y,X
160 FOR X=1 TO 25 STEP 4:PRINT# –1,A$(X),A$(X+1),
    A$(X+2),A$(X+3):NEXT:PRINT# –1,A$(29),A$(30),
    G,I,P,Q,J,K:FOR X=1 TO 30:A$(X)="":NEXT:
    PRINT@0,"*** PLEASE SWITCH RECORDER OFF
    NOW. ***[19xSPC]":GOTO 80
170 FOR X=1 TO 25 STEP 4:INPUT# – 1,A$(X),A$(X+1)
    ,A$(X+2),A$(X+3):NEXT:INPUT# –1,A$(29),A$(30)
    ,G,I,P,Q,J,K:FOR X=1 TO 30:D=–1:FOR Y=15 TO
    44:D=D+2:IF MID$((A$(X)),D,1)="1" THEN S(X+9,
    Y)=1 ELSE S(X+9,Y)=0
180 NEXT Y,X:FOR X=10 TO 39:FOR Y=15 TO 44:IF
    S(X,Y)=1 THEN SET(X,Y) ELSE RESET(X,Y)
190 NEXT Y,X:FOR X=1 TO 30:A$(X)="":NEXT:
    PRINT@0,"*** PLEASE SWITCH RECORDER OFF
    NOW. ***[19xSPC]":GOTO 80
```

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John Hiscott

Continuing our series of owners reports on popular home computers we put the Triton under the microscope.

My personal interests often seem to have called for a means whereby data might be collated, stored and edited. In 1968 I ventured to enquire the cost of a used computer suited to the tasks I had in mind. For the price quoted I could today buy some two hundred Triton kits! Needless to add, computing did not enter my life at that stage. Ten years then elapsed until, in November 1978, I happened to spy the current edition of Electronics Today International which boldly proclaimed the Triton project at a price within the realms of reality whilst at the same time providing the opportunity to undertake a worthwhile construction project. A visit to Transam's shop followed but, chiefly as a result of my total ignorance of the working of computers, I was really no nearer being able to decide whether Triton would do for me what I hoped. However, I resolved to take a chance on what was in any case an exciting project and ordered a kit. Component shortages and apparently unforeseen demand stretched a quoted delivery time of two-and-a-half weeks to something over two months.

Getting It Together

Construction presented no major problems but with over two thousand connections to make on the main board, patience is vital! The suggestion in the manual that the project can be completed "in a couple of evenings" is optimistic for all but the most experienced constructor.

The manual (116 pages) is well written, progressing from construction through operating details to simple machine-code and more extensive Tiny BASIC programming. The instruction for connecting the keyboard strobe was, to me at least, unclear. I feel this is worth mentioning as it is possible to run both Levels 4 and 5 BASIC wrongly connected but Level 6 (Floating-Point) will produce random 'STOP' messages under the same conditions. The GR756 keyboard as supplied requires the strobe connection next to B1 (Bit 1) – top-right on the connector diagram.

Much to my surprise the computer worked on first test! On fitting everything into the case some difficulties were encountered. Some of the screw-holes in the cover did not align with those in the base and enlargement with a small file was necessary. The keyboard was fractionally longer than the bracket into which it was to be fitted and a narrow strip was therefore sawn off its PCB – without any dire effects – fortunately! The five push-button switches as supplied were all of the push-to-make, push-to-break type and three of these had to be opened up to remove the toggle to convert to simple push-to-make operation for Reset, Interrupt 1 and Interrupt 2.

TRITON REVISITED

Now cased and operational, all was well until some ten minutes had passed when the screen display began to break up. I was using a CCTV monitor, without the on-board modulator. The VDU control chip (SFC96364) immediately became suspect and proved to be temperature-sensitive. This was replaced by Transam without question. No further problems have been experienced with the original main-board components.

The final step in the setting-up procedure was to connect the cassette recorder. Here I had the distinct advantage of being able to borrow a "Neal" transcription recorder from my Hi-Fi set-up! This enabled faultless recording from the start (defects in tape excepted). Furthermore I have been able to increase the baud rate to maximum (about 500) without any problems thus giving a reduction in transfer time of more than 50% (for own tapes only, of course). I find that the use of high quality Chromium-dioxide cassettes reduces drop-out to negligible proportions.

Level 4 Software

The original Level 4 monitor (seven functions) includes a 'named file' search in the monitor for cassette input (with a relay for software control of the recorder motor) and also machine-code programming facilities. Use of the 'Reset' button results in '00' being written into all RAM locations which can be very inconvenient if there is no alternative following a program 'crash'. The Tiny BASIC provides adequate scope for a beginner, but the lack of decimal arithmetic became the chief frustration (as an accountant I was formulating ideas for financial programs). Both monitor and BASIC (Level 4) are contained in three 2708 EPROMs on the main board. Also included are 64 graphic characters in ROM which can be displayed in any screen position under program control (memory-mapping).

Growing Triton

The expansion Motherboard and 8K RAM card were announced in Computing Today March 1979. Buffer supply problems delayed completion but construction was straightforward, although the cable connecting Triton and Motherboard called for considerable care. Fixing instructions for the bridge rectifier were not specified in the article mentioned above. This should be bolted to the case or a suitable heat-sink to allow good heat dissipation.

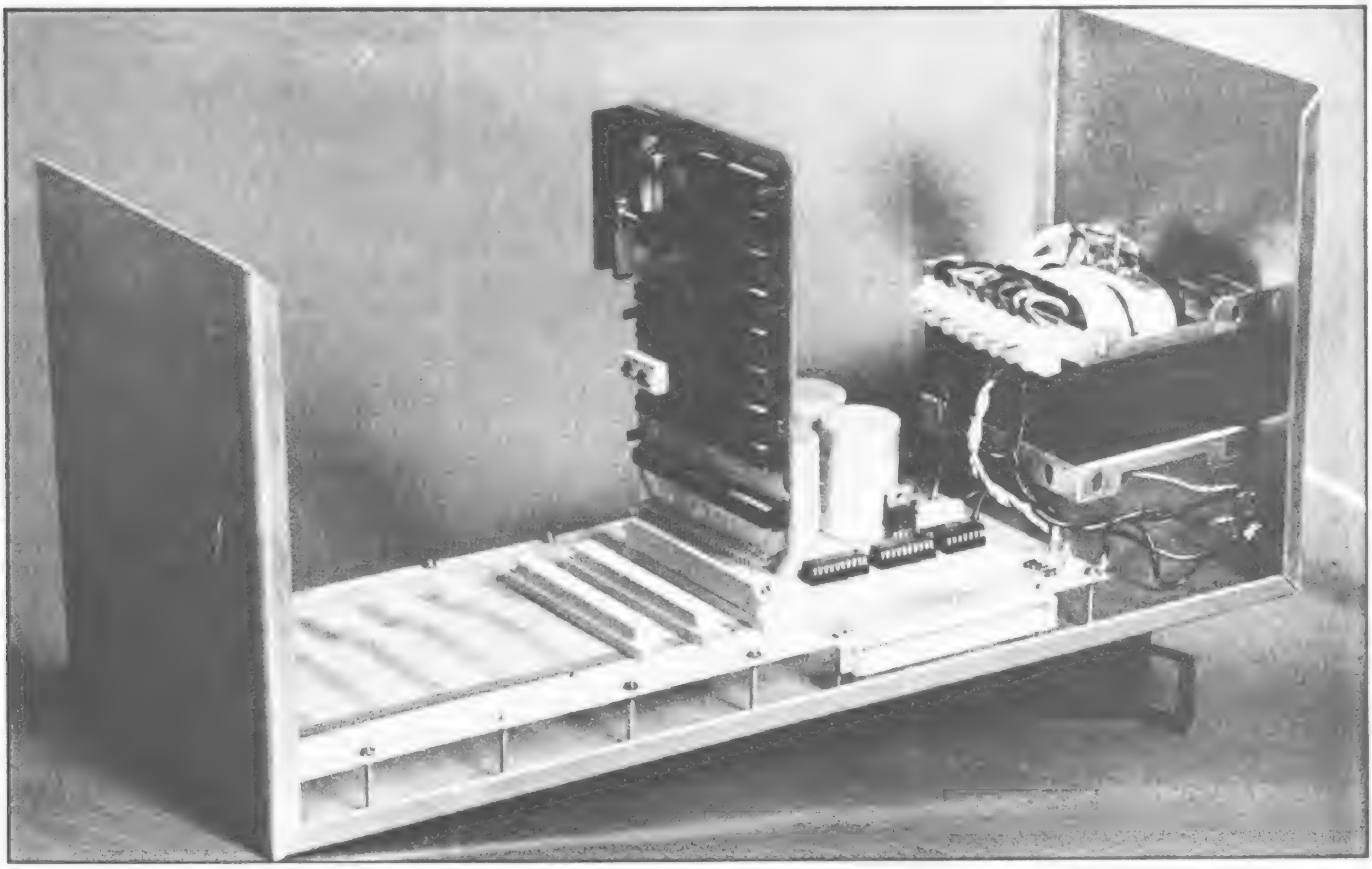
Construction of the 8K RAM card is straightforward and takes an hour or so. This was fitted to the Motherboard and patience rewarded on powering-up and finding nearly 11000 bytes available (the main board holds 2.5K user RAM).

Level 5 Software

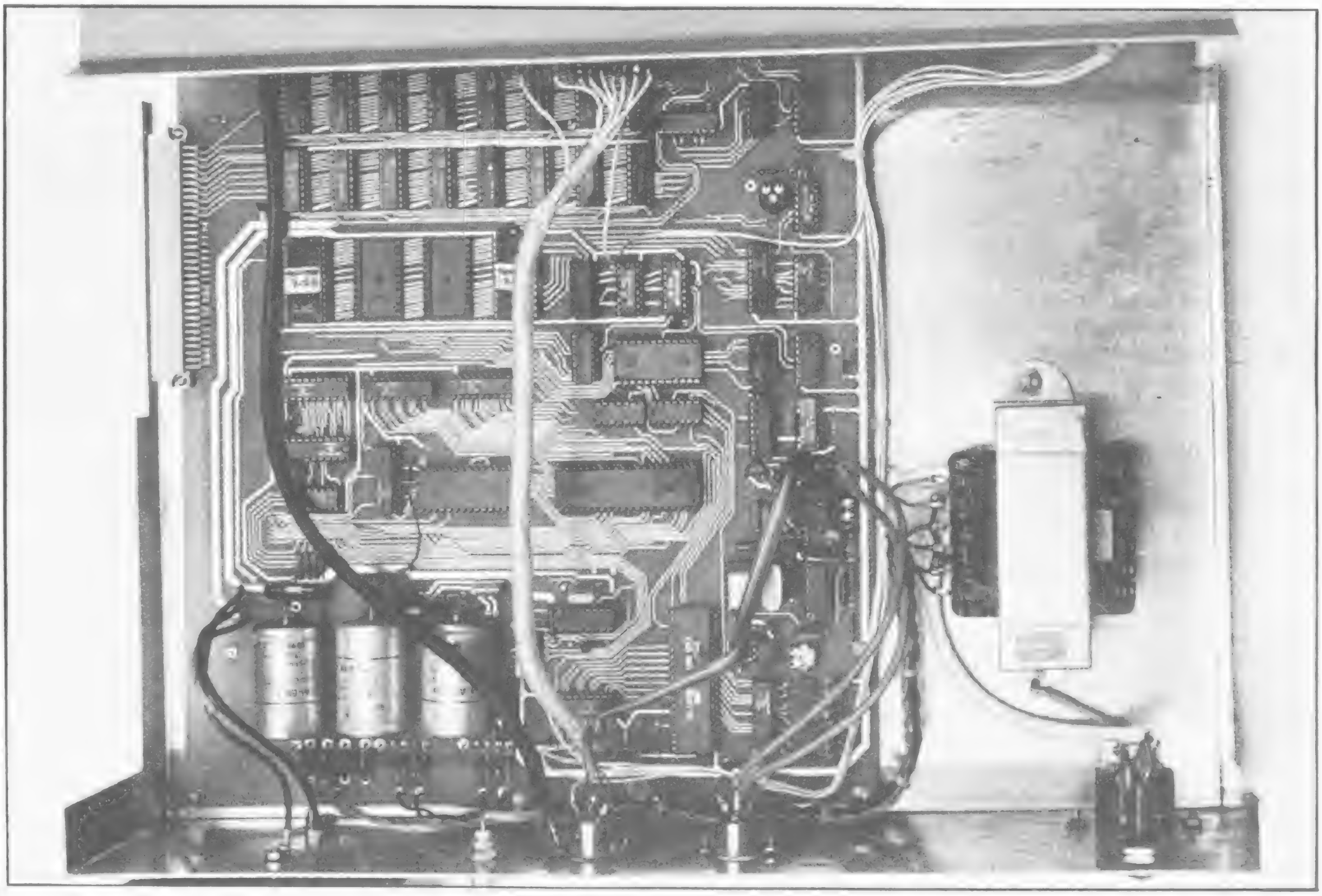
The Level 5 monitor and Extended Tiny BASIC soon followed as described in Computing Today (June and September 1979). The main attraction for me of this new monitor was the serialised printer output set at 110 baud on initialisation but software-controllable (both by machine-code and BASIC).

The 'Reset' button no longer destroys memory but clearance and testing of RAM is still optional. In this and subsequent monitors, use of 'Interrupt 2' displays the register contents of the microprocessor.

Level 5 Extended Tiny (Integer) BASIC includes the additional Edit, Peek, Poke, Read, Write and Call instructions and is contained with the monitor in four 2708 EPROMS



Triton's motherboard assembly fitted with an 8K RAM plane.



The internals of our office Triton, fitted with Level 7.2 and using a monitor rather than a TV.

which are housed on the main board. For anyone considering starting with Tiny BASIC there now seems to be little point in considering Level 4. Level 5 offers much more for the additional cost of one EPROM.

The printer switch can be 'POKED' at any point in a program thus allowing printed input as well as output. This facility is retained in Levels 6 and 7 BASIC also.

Going Into Print

Choosing a printer became the next priority. The latest machines were expensive but a used Teletype seemed an economical alternative. A second-hand model 33KSR was therefore purchased. A 20 mA current loop interface was needed and the circuit specified in the Level 5 monitor documentation built at a cost of 65 pence!

Of the Teletype's four connecting wires, the input pair were identified as those which produced a response from the machine when shorted together. These were connected to Triton and on typing the letter V in response to the monitor's prompt the message was again tapped out by the Teletype — much to my joy and satisfaction! The hard-copy lacks lower-case and graphics but is entirely accurate although the printing speed of 10 characters per second is slow by current standards.

For the benefit of would-be purchasers of elderly Teletype machines I would mention that thorough lubrication is necessary because, being so complex, seizure of the working parts can occur on being left unused for a long period.

Triton's Second Daughter

The 8K EPROM card was announced in Electronics Today for June 1979. This plugs into the Motherboard. It was constructed without difficulty in anticipation of the scientific BASIC and assembly package which were to become available later. There seems to me, however, to be a minor fault in the design of the 8K EPROM card. The −5 V regulator, although sharing the same heatsink as the two positive regulators, must of course be insulated. The electrical insulation does, however, provide effective thermal insulation also and this gave rise to problems which were, happily, completely cured by fitting the negative regulator with its own small aluminium heatsink.

Level 6 Software

The Level 6 Floating-point BASIC in seven 2708's became available in June 1979 and was fitted to the completed EPROM card. This provides the BASIC programmer with the scope to venture into the commercial and scientific world. The added facility of being able to format numerical output to the desired number of decimal places, with trailing zeros makes this the ideal BASIC for financial programming (to six significant figures). String handling is, however, not available and the running speed won't break any records! Error messages are conveniently presented in English rather than as coded abbreviations (Level 7 also).

Unlike Levels 4 and 5, cassette load and save is performed by BASIC although the monitor still retains a tape input/output routine which is restricted to data at address

1602H upwards. This seems to be a legacy from the previous Levels 4 and 5 which located Tiny BASIC start of text at 1602H. Would it not be more useful to enable start and end addresses to be specified in the monitor tape routines? This would permit easy loading of, for example, the Level 6 BASIC Interpreter for those who might prefer to use cassette rather than EPROMs for storage (likewise Level 7). After all, Transam sell listings of their software and if you have the patience to type some 7 or 8 thousand bytes into memory the cost, compared to EPROMs is minimal. When operating in Level 6 BASIC, machine code programs can be saved simply by specifying start and end addresses (in decimal). Using this facility, BASIC programs can be taped complete with all variables (these are stored at the top of the usable RAM which can be truncated by program as required). My own personal accounting program, in Computing Today October 1979, uses this facility to store account balances.

August 1979 saw the arrival of the Level 6 monitor with no less than 25 functions! Control and formatting for the printer remains unchanged but there is the added advantage that output is also displayed on the screen, thus providing the useful option of a "slow-motion" display. An alternative version of the monitor is also available for driving a high-speed parallel printer.

Single key-stroke access to BASIC is included, either for clearance or retention of program, as well as to the new Triton Resident Assembly-language Package ("TRAP").

TRAP It With Triton

Occupying a full 8K EPROM card, "TRAP" allows extensive text editing and machine-code programming facilities. The assembler and dis-assembler use standard 8080 Intel mnemonics and provide optional printer output. I have only one small grumble about this otherwise excellent package, namely, when printing an assembly listing there is insufficient delay for the Teletype's carriage return. On a short line there is little effect: on a long line overprinting of the first few characters occurs (the Teletype has no buffer and prints as the characters are output).

Machine code input is possible with all the Triton monitors, but "TRAP" is a must if you fancy direct manipulation of the CPU combined with the convenience of using the 8080 instruction set command words (see article in Electronics Today for December 1978). Trace, Single-stepping and Breakpoints are all present to help with de-bugging. The editor, under control of which assembly language programs are formulated, is equally useful for word-processing. This article was originally produced in this way, being temporarily stored on cassette then added to and edited on numerous occasions until being printed by the Teletype.

The announcement in December 1979 of Level 7 Extended BASIC, Level 8 Pascal compiler and the Level 9 CP/M disc system must undoubtedly establish Triton as one of the most versatile microcomputers available and it is this aspect which must be significant when considering Triton's position in relation to the obvious competitors.

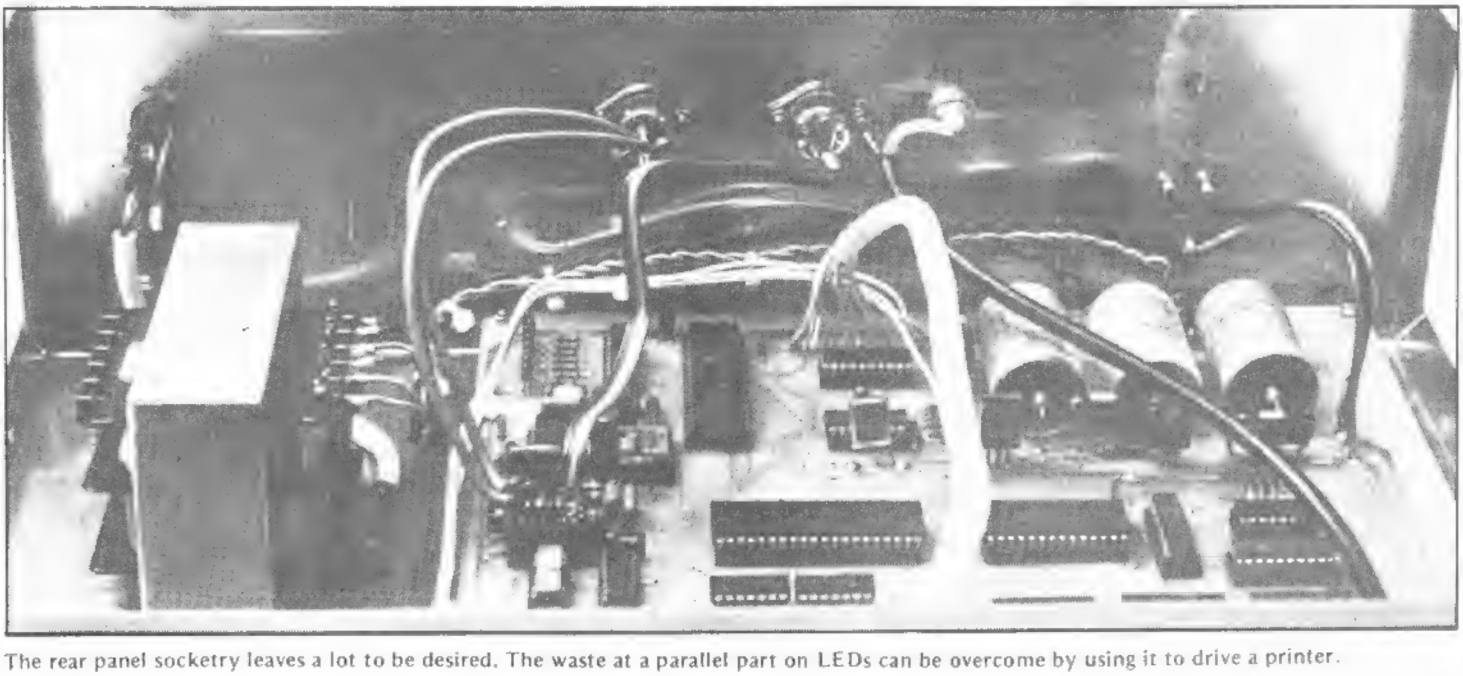
For those who may be interested in updating their software it is worth mentioning that Transam will exchange or re-program your EPROMs, subject to a small service charge. I feel, however, that this might well be a mixed blessing — an erased and possibly much used 2708 must necessarily be potentially less reliable than a brand new device but on balance the arrangement is financially attractive.

Level 7 Software

The Level 7 (8K) BASIC is fast and has an extensive range of commands and functions. Worthy of mention is 'GET' which reads the keyboard without use of the return key and 'TRACE' which displays the number of each line as it is executed to help with de-bugging programs.

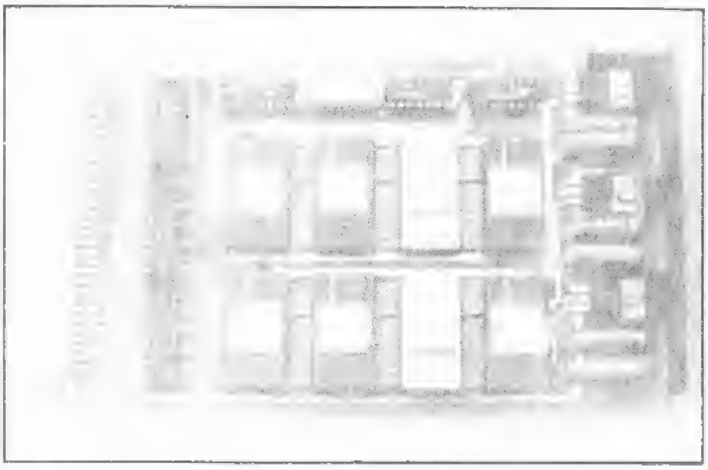
The ability to load and save arrays at any time under program control provides extensive data processing capability. Cassette files can be identified by headers (or not) as required and there is the advantage (compared with Levels 4, 5 and 6) that a load operation is not aborted to the command state when an error is detected, thus providing the opportunity to list the input and attempt a correction.

A further innovation is that a BASIC program will run automatically on completion of loading from cassette. Numerical data can be specified in either hexadecimal or decimal form but it seems unfortunate (from my point of view) that the figure-formatting available in Level 6 has not been incorporated; for example, a figure of five pounds



The rear panel socketry leaves a lot to be desired. The waste at a parallel part on LEDs can be overcome by using it to drive a printer.

CTs solution to the switches can be seen top right, a PCB!



Level 7.2 BASIC needs a card all of its own, and a motherboard!

prints simply as '5' whereas in Level 6 it can be printed as '5.00' thus making for much tidier financial programming. A characteristic of this, and probably other, BASICs is the occasional emergence of very small mathematical inaccuracies. This feature was very ably illustrated by Mr. Lusty in the January 1980 edition of Computing Today. Whilst generally of little or no consequence, havoc can be wreaked in financial programs. Fortunately the solution is simple and consists of rounding the value of variables or output to the required number of decimal places. The Level 7 documentation gives the formula which can be specified as a 'user function' for both convenience and economy of memory space.

Control of the printer remains unchanged except that the conventional command 'LPRINT' has been included. This only directs output to the printer for the line specified. String-handling is well supported with eleven functions, for the benefit of anyone who is unfamiliar with the terminology, a 'string' is a sequence of alphabetical and/or numerical characters (e.g. a word) which can be recognised in whole or in various parts by the program. All aspects considered, the Level 7 monitor and BASIC comprise a most versatile software package.

An EPROM programming card (useable with Levels 6, 7 and 8 monitors) is now available so, having created your very own language using "TRAP" you can 'burn' it in to become part of the resident software!) Personal extensions to the Levels 6 and 7 (2K) monitors are also practicable using the unoccupied (Tiny BASIC) sockets on the main board. The constructor is at liberty to set the CPU clock speed by altering the value of the controlling crystal. The standard values are 7.168 MHz or 18 MHz for which alternative versions of software are available. The latter gives an actual clock speed of about 2 MHz.

Level 8 Software

Level 8 Pascal comprises a 4K monitor/editor resident on the main-board with a 20K compiler/interpreter located on the Motherboard. Although offering greater scope than BASIC it should be remembered that Pascal has not gained wide popularity amongst microcomputer users. This situation may well change but for the present the Pascal enthusiast does not enjoy the scope for exchange of software and ideas available to the BASIC programmer.

Level 9 Software/Hardware

The Level 9 disc system comprises disc drive(s) with power supply, S100 controller card and a small interface card which is connected to the Motherboard. The CP/M operating system (on disc) replaces the onboard monitor, BASIC, assembler or other firmware. Purchasing the CP/M system (and becoming a registered user) gives access to vast amounts of free (yes, *free*) software available for the cost only of the discs on which supplied. The operating system requires a minimum of 16K RAM in which to work although many languages and programs will need more memory than this.

Documentation

Transam's documentation for the software packages is usually excellent although the 39 page Level 7 documentation is perhaps not quite so thorough in the step-by-step examples as its predecessors — but having progressed through the three previous BASICs, I found that a little experimentation soon resolved small misunderstandings.

In all cases the addresses of the monitor sub-routines are listed and these can be called from BASIC (except when in Level 4).

Considerations

For those constructors who may be about to launch into computing I would recommend serious consideration being given to Triton. The work is rewarding, and some initiative is called for to overcome the snags which are likely to arise, but the end product is a most practicable and versatile piece of equipment which is supported by easy-to-use software.

With a product of this nature it is reasonable that a prospective purchaser should ask what standard of service he might expect from a would-be supplier. My own experience suggests that Transam were overwhelmed by the initial demand for Triton. In the original kit some items were omitted in error and this situation subsequently arose twice when I called at their shop to collect RAM and EPROM card kits in mid-1979. Since then, Transam seem to have come to terms with the fact that good service is at least as important as the product and, more recently, a faulty EPROM card was replaced and returned to me within a week. When my Level 7 monitor suffered a brainstorm I was able to call at Transam's shop where the problem chip was quickly identified and a replacement programmed on the spot.

If you have a Triton you have the reassurance that problems can be discussed with those who sell and know the computer. This is an aspect which I, and no doubt others, regard as an important consideration.

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Trevor Lusty

Primarily we discover the solution to a nutty problem.

Prime numbers can be divided into several categories according to how hard it is to find them. I suggest the following rough definitions : –

a) Easy primes – – those which may be found by mental arithmetic. (eg. 2, 3, 5, 7, 11, 13 etc.)
b) Reasonable primes – – those which fit into a single variable, but which are unlikely to be found by mental arithmetic. (eg. 8707, 9721, 15137 etc.)
c) Hard primes – – those which nearly fit into a single variable. (eg. 1653701519 etc.)
d) Unreasonable primes – – those which, because of their size, can only be found by special mathematical methods. (eg. 2**21701 – 1 has 6533 digits)

It is worth noting that we only require reasonable primes to solve our problem, for although the number 385,640,866, 350,419 will not fit into a single precision variable the prime factors do. We are, therefore, left with two problems. Firstly, how do we find reasonable prime numbers and secondly, how do we test to find whether or not they are factors of our number.

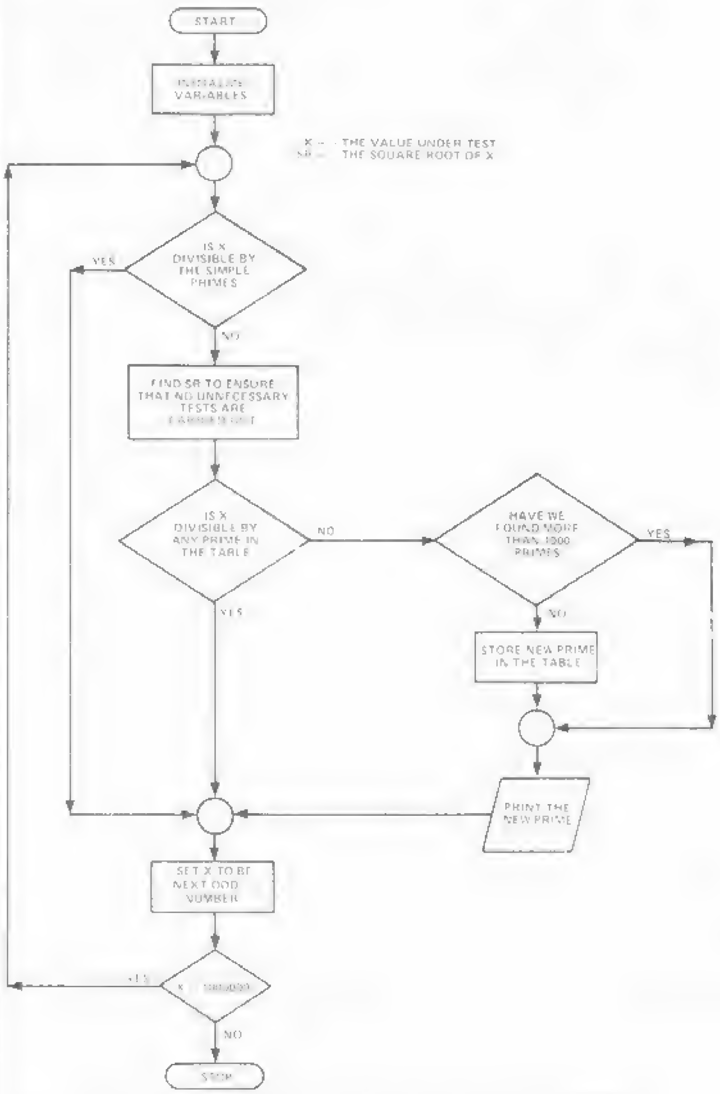


Fig.1. Flowchart to find all prime numbers less than 1,000,000.

Finding Reasonable Primes

To prove that a number is prime we must ensure that it has no factors other than itself and one. Fortunately, it is only necessary to test the primes not exceeding the square root of the number. We know, for example, that 113 is prime because none of the set (2, 3, 5, 7) are factors. Unfortunately, the primes from 2 to 113 can only find primes up to 16127 and you can bet your chips that the factors of my number are bigger than that!

What we can do is to use easy primes to discover more primes, which we store in an array. The primes discovered in this way can then be used to find even larger primes. eg. if we store 1000 primes then these can be used to test all numbers up to about 50,000,000. The flowchart for this method is shown in figure 1 and gives the algorithm for the BASIC program (figure 2) from line 250 to line 500 with the exception of the subroutine calls.

```
100 REM ******************************
110 REM *                            *
120 REM * PROGRAM --- PRIME HUNTING  *
130 REM *                            *
140 REM * PROGRAMMED IN  PET  BASIC  *
150 REM *                            *
160 REM * TREVOR L LUSTY [illegible] *
170 REM *                            *
180 REM ******************************
190 A1 = 385640[illegible]
[illegible]
270 LET [illegible] = B : GOSUB 510 : PRINT [illegible]
280 LET [illegible] = C : GOSUB 510 : PRINT [illegible]
[illegible]
300 LET [illegible] = E : GOSUB 510 : PRINT [illegible]
310 LET [illegible] = F : GOSUB 51[illegible]
320 LET P(1) = 13 [illegible] = 15 [illegible]
330 IF [illegible] = B*INT([illegible]) THEN 4[illegible]
340 IF [illegible] = C*INT([illegible]) THEN [illegible]
350 IF [illegible] = D*INT([illegible]) THEN 4[illegible]
360 IF [illegible] = E*INT([illegible]) THEN 4[illegible]
370 LET SR = S[illegible]
380 FOR I = 1 [illegible]
390 LET N [illegible]
400 IF N [illegible] SR THEN [illegible]
410 IF [illegible] = N*INT([illegible]) THEN 4[illegible]
[illegible]
4[illegible] IF [illegible] 1000000 THEN [illegible]
[illegible]
510 LET S = A1-[illegible]*INT(A1/[illegible])
520 LET B2 = 100*S+A2
530 LET S = B2-[illegible]*INT(B2/[illegible])
540 LET B2 = 100*S+A3
550 LET S = B2-[illegible]*INT(B2/[illegible])
560 LET B2 = 100*S+A4
570 LET S = B2-[illegible]*INT(B2/[illegible])
580 LET B2 = 100*S+A5
590 LET S = B2-[illegible]*INT(B2/[illegible])
600 IF S [illegible] 0 THEN RETURN
610 PRINT
620 PRINT "ONE FACTOR OF THE NUMBER"
630 PRINT " IS";[illegible]
640 END
```

Fig.2. This program will find prime factors of large numbers.

As this part of the program will have to be executed many times, it must be carefully examined to ensure that it is efficient. It is for this reason that commonly used numbers are stored in simple variables. Subscripted variables require much more execution time and an initial sieving by 2, 3, 5, 7 and 11 means that only about 10% of the numbers tested need use them. Please don't write to tell me how this routine can be further improved. I can think of several ways myself, but they make the method harder to understand and if we really want an efficient program we should use a language other than BASIC.

The rest of the program is just long division and uses techniques which have been described in previous Problem Pages. The factors of the number given are 72661, 72727 and 72977. If you are interested in finding large primes I suggest you read The Art of Computer Programming — — Volume 2 : Seminumerical Algorithms by Donald E. Knuth. It is also interesting to note that the largest known prime was found by a schoolboy!

Lots Of Coconuts

There seem to be two reasons for tackling the problems set on this page. One is for fun and the other is to learn new techniques or limitations which help to improve our general programming ability. There were so many letters and queries following my Square Triangles problem that I thought a similar problem was called for — — hence Coconuts.

```
1000 REM *********************
1020 REM * LOTS OF COCONUTS *
1040 REM *                  *
1060 REM *  PROBLEM PAGE    *
1080 REM *  SOLUTION NO.7   *
1100 REM *********************
1120 LET P = 1              REM *** SET FIRST COCONUT ON APEX ***
1140 LET T = 3              REM *** FIRST LAYER BELOW APEX ***
1160 LET N = 2              REM *** DIFFERENCE BETWEEN LAYERS ***
1180 LET P = P+T            REM *** ADD ON NEXT LAYER ***
1200 LET S = SQR(P)         REM *** FIND SQUARE ROOT OF TOTAL ***
1220 LET S = INT(S+.005)    REM *** FIND INTEGER PART OF ROOT ***
1240 IF S*S <> P THEN 1320  REM *** COMPARE SQUARE TO TOTAL ***
1260 PRINT:PRINT:PRINT
1280 PRINT "THE PYRAMID HAS";N;"LAYERS WITH";T;"COCONUTS"
1300 PRINT "IN THE LOWEST LAYER.
     THE TOTAL NUMBER OF NUTS IS";P
1320 LET N = N+1                 REM *** SET NEW ROW TOTAL ***
1340 LET T = T+N                 REM *** FORM NEXT LAYER TOTAL ***
1360 IF  T < 1000001  THEN 1180 REM *** HOW MANY NUTS PER LAYER ***
1380 END
READY.

THE PYRAMID HAS 2 LAYERS WITH 3 COCONUTS
IN THE LOWEST LAYER.  THE TOTAL NUMBER OF NUTS IS 4


THE PYRAMID HAS 48 LAYERS WITH 1176 COCONUTS
IN THE LOWEST LAYER.  THE TOTAL NUMBER OF NUTS IS 19600
```

Fig.3. How the square root function is used.

My reason for setting the original problem was to highlight difficulties which are often encountered with the square root function. The same difficulties can occur with this problem if you choose to solve it by my first method (figure 3). This is the method which I feel is the easiest to understand and it is worth noting that an elegant program which saves two minutes computing time but takes two hours longer to write is only an improvement if it is to be run many times. If your program has to be used by others, the maxim 'Keep it Simple' has a lot to recommend it.

Just as triangle numbers were formed by adding the integers, so pyramid numbers can be found by adding the triangle numbers. The base of our pyramid is a triangle and the next pyramid is formed by adding the next triangular base. The following table reveals all:-

INTEGERS	TRIANGLE NO.	PYRAMID NO.
1	1	1
2	2 + 1 = 3	3 + 1 = 4
3	3 + 3 = 6	6 + 4 = 10
4	4 + 6 = 10	10 + 10 = 20
5	5 + 10 = 15	15 + 20 = 35
6	6 + 15 = 21	21 + 35 = 56

Store N holds the integers, store T the triangle numbers and store P the pyramid numbers. I feel that there are sufficient remark statements in the program for you to work the rest out for yourselves.

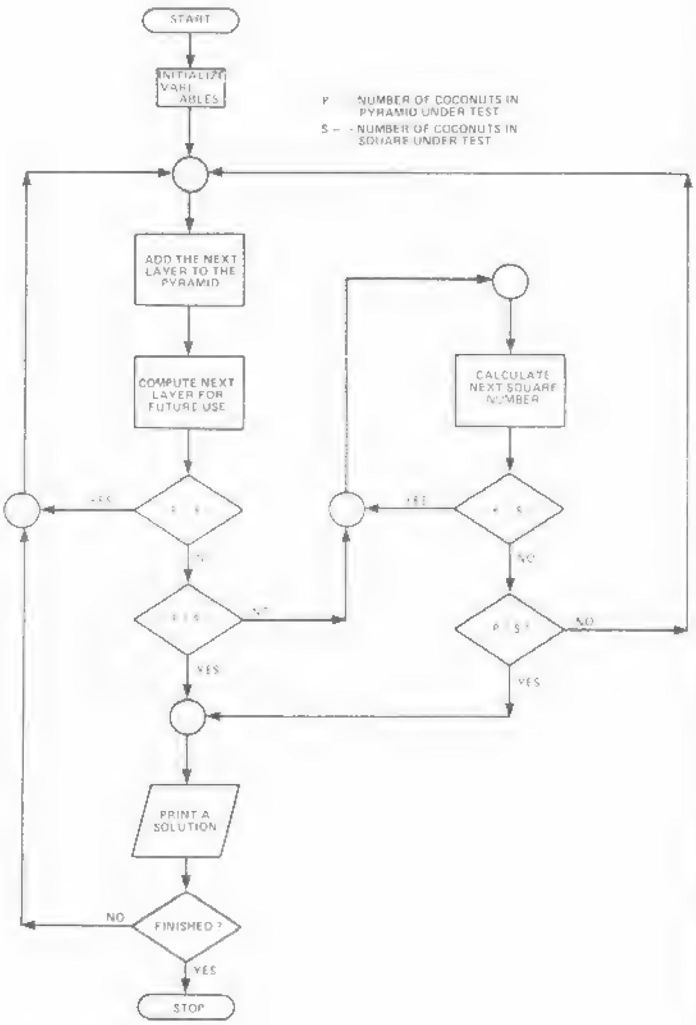


Fig.4. Note the symmetry.

Method 2

Now what set the cat amongst the pigeons with the original problem was that some people don't have square root functions. Many searched for, and found, an alternative solution. After all, if we can find one set of values by adding a sequence of numbers together, why not try the same method with the squares. The easiest way I have found to visualise this method is to think of a child building two towers of wooden bricks. One tower is always a square number of bricks high and the other height represents the pyramid number. If we can find a situation where the heights of the two towers are equal then we have solved our problem.

```
1000 REM ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
1020 REM ◆ LOTS OF COCONUTS ◆
1030 REM ◆ SECOND SOLUTION. ◆
1040 REM ◆                  ◆
1060 REM ◆   PROBLEM PAGE   ◆
1080 REM ◆   SOLUTION NO.7  ◆
1100 REM ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
1200 LET P=1 T=3 N=2 S=1 M=3 REM ◆◆◆ SET UP INITIAL VALUES ◆◆◆
1220 LET P=P+T N=N+1 T=T+N    REM ◆◆◆ ADD NEXT LAYER TO PYRAMID ◆◆◆
1240 IF P<S THEN 1220         REM ◆◆◆ NUMBER < CURRENT SQUARE ? ◆◆◆
1250 IF P=S THEN 1320         REM ◆◆◆ HAVE WE FOUND A SOLUTION ◆◆◆
1260 LET S=S+M M=M+2          REM ◆◆◆ CALCULATE NEXT SQUARE ◆◆◆
1280 IF P>S THEN 1260         REM ◆◆◆ PYRAMID > SQUARE ? ◆◆◆
1300 IF P<>S THEN 1360        REM ◆◆◆ HAVE WE FOUND A SOLUTION ◆◆◆
1310 PRINT PRINT PRINT
1320 PRINT "THERE ARE";N-1 "LAYERS AND";T-N;"NUTS IN THE"
1340 PRINT "LOWEST LAYER. THE TOTAL NUMBER OF NUTS IS" P
1360 IF T<1000000 THEN 1220 REM ◆◆◆ HAVE WE FINISHED ? ◆◆◆
1380 END
```

Fig.5. Solution program compares totals.

The flowchart (figure 4) and program (figure 5) show the details of this method. The pyramid numbers are found by the method above and the square numbers in store S by adding the odd integers. In fact, as we are not interested in the total heights of the towers, but only the difference between them. The size of the numbers may be reduced by using method 3 (figure 6). This method is most useful when using limited precision Integer BASIC.

With the square triangles problem it was possible to find a recurrence relation and this proved much faster than any of those above. Such relationships do not always exist, and I have been unable to find a suitable one for this problem. It is just possible that no more solutions even exist.

```
1000 REM ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
1020 REM ◆ LOTS OF COCONUTS ◆
1040 REM ◆  THIRD SOLUTION  ◆
1060 REM ◆                  ◆
1080 REM ◆   PROBLEM PAGE   ◆
1100 REM ◆   SOLUTION NO.   ◆
1120 REM ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
1140 LET P=1 T=3 N=2 S=0 M=1 REM ◆◆◆ SET UP INITIAL VALUES ◆◆◆
1160 LET P=P+T N=N+1 T=T+N    REM ◆◆◆ ADD NEXT LAYER OF PYRAMID ◆◆◆
1180 IF P<0 THEN 1160         REM ◆◆◆ ADD ANOTHER LAYER ? ◆◆◆
1200 IF P=0 THEN 1280         REM ◆◆◆ DO WE HAVE A SOLUTION ? ◆◆◆
1220 LET P=P-M M=M+2 S=S+1    REM ◆◆◆ SUBTRACT LAYER OF SQUARE ◆◆◆
1240 IF P>0 THEN 1220         REM ◆◆◆ SUBTRACT ANOTHER LAYER ? ◆◆◆
1260 IF P<>0 THEN 1340        REM ◆◆◆ DO WE HAVE A SOLUTION ? ◆◆◆
1280 PRINT PRINT PRINT
1300 PRINT "THERE ARE" N-1;"LAYERS AND";T-N;"NUTS IN THE
1320 PRINT "LOWEST LAYER. THE TOTAL NUMBER OF NUTS IS";+◆
1340 IF T<1000000 THEN 1160  REM ◆◆◆ HAVE WE FINISHED ? ◆◆◆
1360 END
```

Fig.6. Vive la difference! Another version.

What The Programmer Said

Variety is the spice of life, or so they say, and there should be something in the following problems for everyone. The first requires no programming at all, the second just one line and the third is for those of you who can't do the first two!

A sociologist, a physicist and a computer programmer were travelling in a train when they saw three sheep standing still in a field. 'I didn't know they had any black sheep in this area' said the sociologist. 'In this area there is at least one black sheep.' said the physicist. Now, you don't have to program for very long before you realise that you must not take anything for granted — — so what did the computer programmer say?

Biggest Of Three

There are no IF's THEN's or ELSE's in this two line programming problem, and no multiple statement lines either. The first line inputs three numbers in any order ie. 10 INPUT A,B,C and the second prints the largest of the three numbers only. What function follows the PRINT statement in the second line?

Base Changing

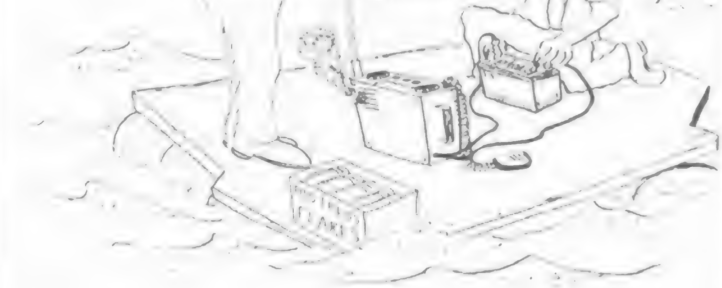
Those of you that have done any machine code programming will know how useful it is to have a conversion table from decimal to hex. If you have not already done so write a program to produce such a table. If you don't have a hard copy facility then write a program which inputs a base 10 integer and converts it to bases 2 to 16.

Post Script

This is a special for PET owners. I have seen a certain amount of discussion recently about how to get one's revenge on MICROCHESS 2.0 by Peter Jennings. The quickest win I have seen published at level 8 is 22 moves, and this did not work with my version. Not to be outdone I offer the solution below. Mate takes only fifteen moves at level 8 and can be entered with a playing time for white of under a minute.

WHITE		BLACK (PET)
D2–D4	Queen's pawn gambit	D7–D5
G1–F3	Knight protects pawn	C8–G4
D1–D3	Queen advances	B8–C6
D3–B5	Queen pins knight	A8–B8
F3–E5	Knight advances	A7–A6
B5–A4	Queen retreats	G4–F5
E5–C6	Knight takes knight	B7–C6
A4–C6	Queen takes pawn	D8–D7
C6–A6	Queen takes pawn	F5–C2
C1–F4	Bishop threatens pawn	B8–B2
A6–A7	Queen advances	B2–B1
A1–B1	Rook takes rook	C2–B1
F4–C7	Bishop takes pawn	B1–A2
A7–A8	Check	D7–C8
A8–C8	Mate	

The problem is to try to find a quicker mate at level 8.



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Information to allow him to design his own circuits quickly and simply is sadly lacking. Books take everything too seriously and at too much length. Looking anything up takes hours — by which time the rain has stopped and . . . . . .

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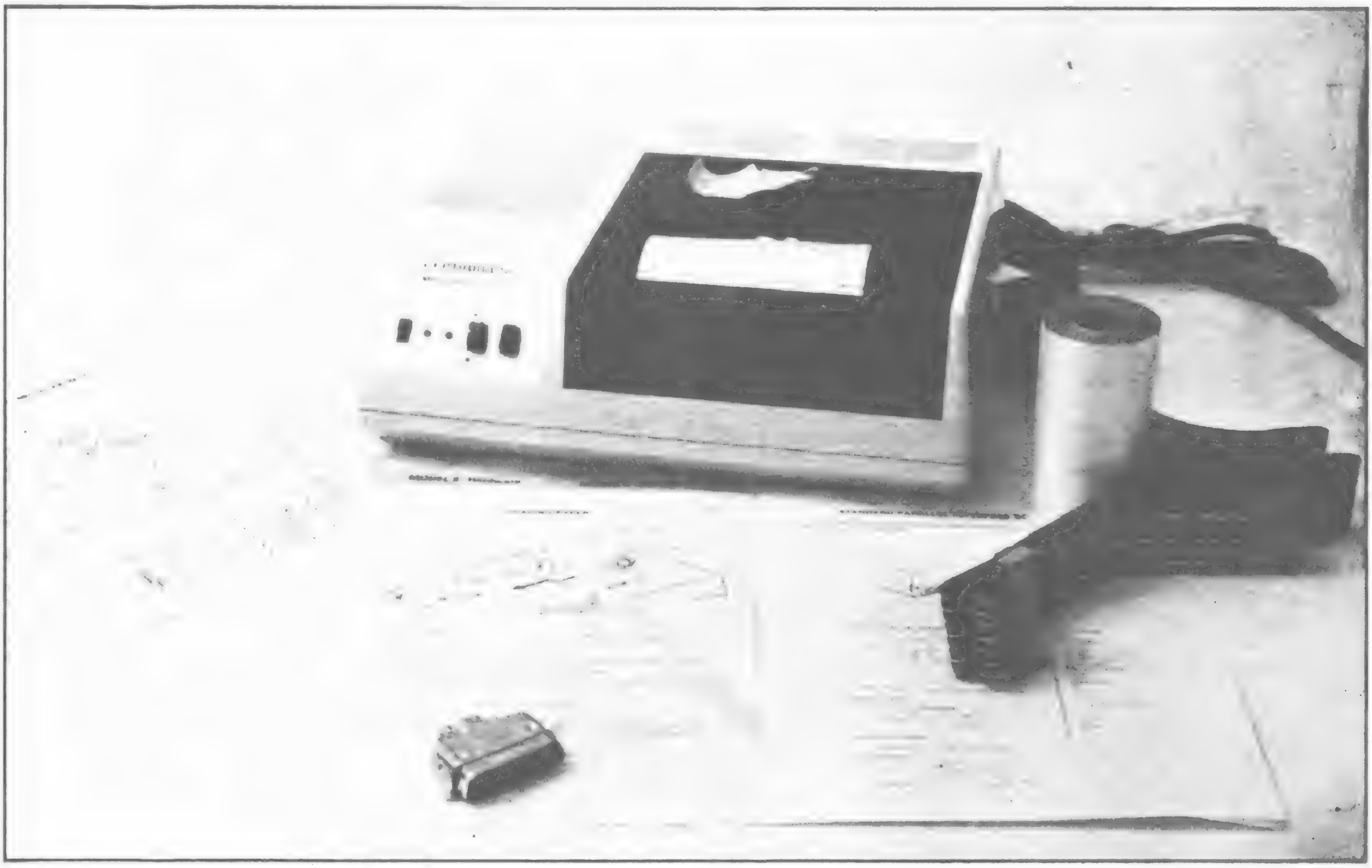

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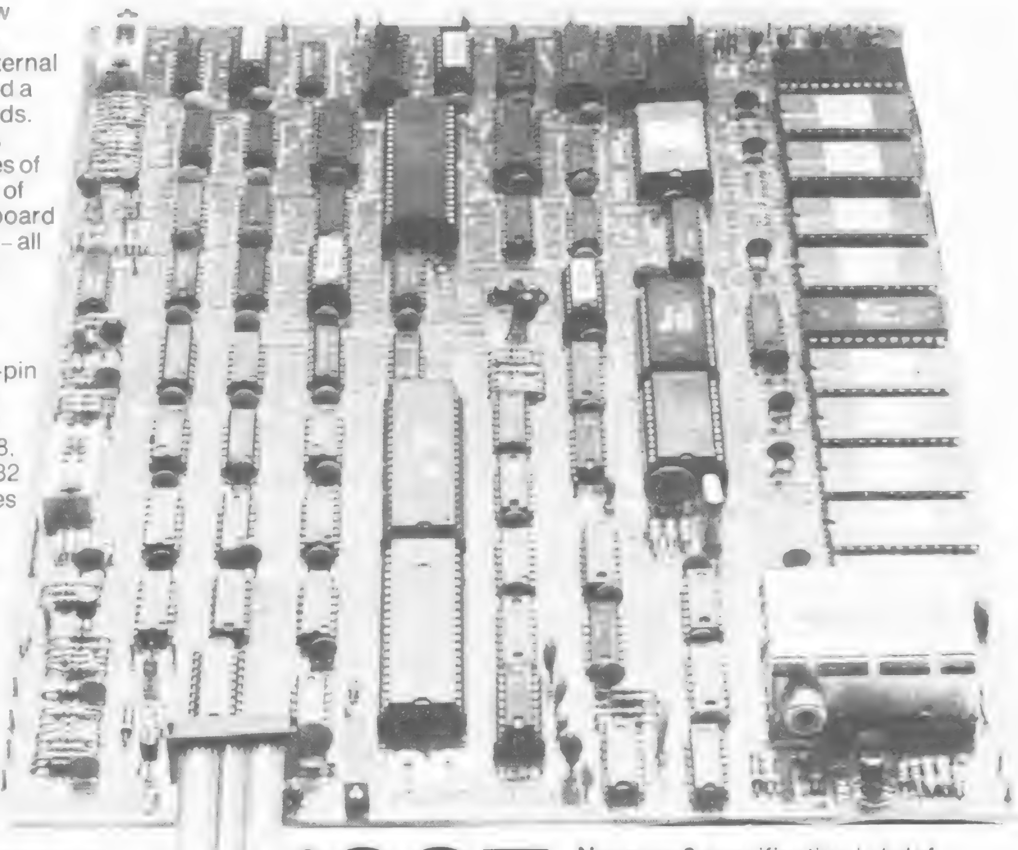

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Nascom-2 specification in brief

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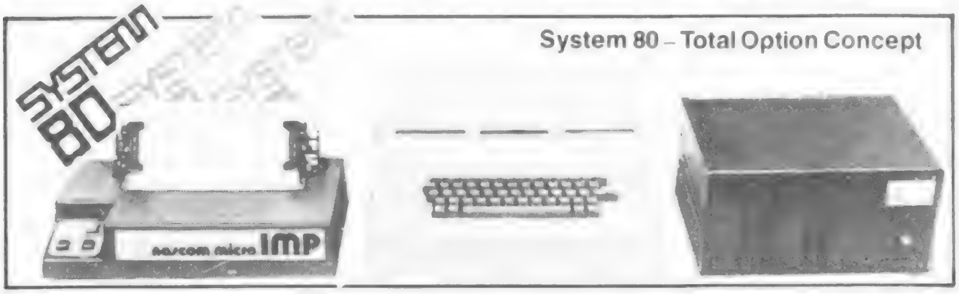
On board interfaces: Domestic TV at 50Hz 625 lines (adaptablre to 60Hz/525 lines) displaying 16 lines of 48 characters.
Kansas City type audio cassette (300/1200 baud) or Teletype. RS232 for printer. 16 free, programmable P 10 lines.
Graphics: 2K bytes of ROM: 128 graphics characters, 128 character ASCII with full upper and lower case Alphanumerics.



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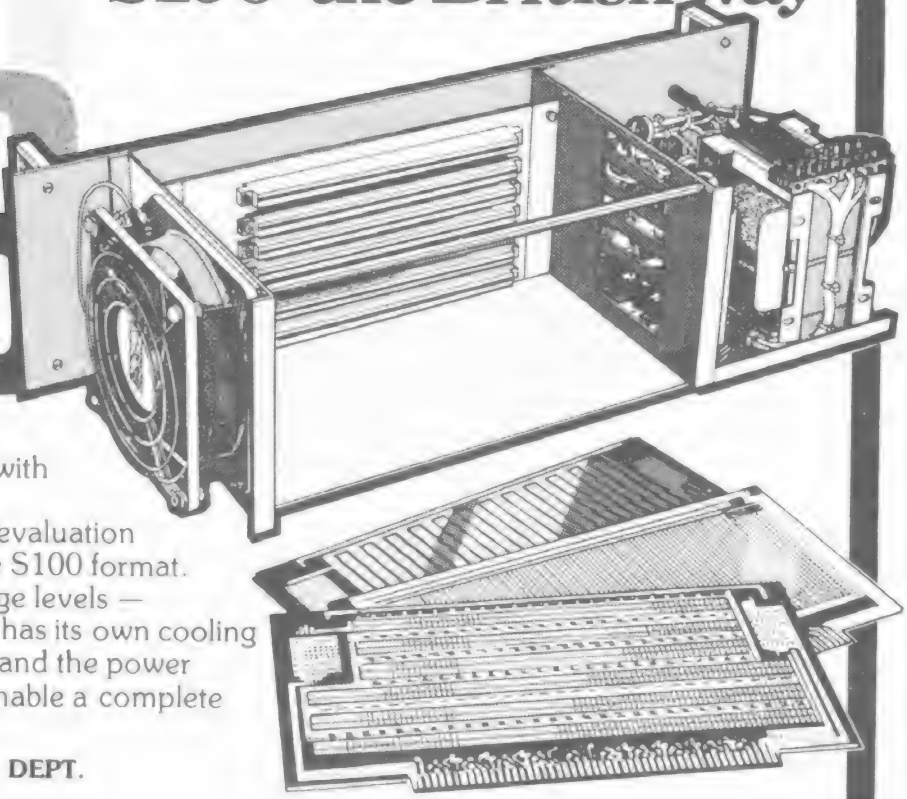

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Further investigation into the dim world of machine code reveals some basic concepts.

Last month we investigated the structure and interconnection of CPU devices and the building blocks that go with them to make a system. This month we shall build on that information and consider in detail the form of machine code instructions, what they do and how they are used, but first a few paragraphs explaining the hexadecimal notation that is used for the representation of numbers.

Hexadecimal Notation

It was seen last month that all information to and from a CPU and its external memory was transferred via the 8 or 16-way data bus, and also that memory addresses were produced on the 16-way address bus in binary. Now this binary code is the method used by computers to register numbers using only the two states that it has at its disposal: *ON* or *OFF*. With a number system based on '2' (hence the name binary) this representation will take the form shown below :–

base 2	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
decimal	128	64	32	16	8	4	2	1

By indicating which values when added together make the required number the binary representation is formed, hence 100 decimal is :–

base 2	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
decimal	128	64	32	16	8	4	2	1
$(100)_{10}$	0	1	1	0	0	1	0	0

because 64 + 32 + 4 = 100.

Now, were it necessary to talk to a computer in binary the task would soon become very arduous. To remember a binary string of 8 or 16 characters in length is difficult and to enter such a string would be unreliable and time consuming. So a sort of shorthand is used called HEXADECIMAL notation.

By taking 4 binary 'bits' the largest number that can be formed is 15, ie 8 + 4 + 2 + 1. Now by assigning 16 characters to represent 0 – 15 as follows :–

decimal	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
hexa-decimal	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

each 4 binary 'bits' can be represented by a single character. Hence decimal 100 in binary is 0 1 1 0 / 0 1 0 0 and in Hexadecimal is 64

Another example the binary address 1 1 1 0 / 1 0 0 1 / 0 0 1 0 / 1 1 1 1 in Hex simplifies to E92F or decimal 59,695

It is essential that this notation is understood before reading on so if you are not quite sure go through it again.

Register Load And Move Instruction

Just as the internal program of the CPU carries out instructions by moving data from one register to another so do user programs. For that purpose a comprehensive set of Load and Move instructions are provided. The main types are shown below :–

- Load — Put a given value in a specified register eg LD A, 30 H, MVI A, 30 H
- Move (8 bits) — Put the contents of one register into another register eg LD D, B or MOV D, B. In this case it is the contents of B that are moved to D
- Move (16 bits) — As for Move (8 bits) except it moves the 16 bits of a register pair eg LD SP, HL or SPHL

Another very important type of instruction in this category is called INDEXED ADDRESSING and as its concepts seem to give beginners sleepless nights I have chosen to deal with this whole topic in a later paragraph.

The final group of these instructions are known, in Intel jargon, as PUSH and POP. Here the content of a defined register pair is moved onto the top of the stack by the PUSH instruction and can be returned to a defined pair of registers with a POP instruction.

An example of stack operation would simplify this explanation.

Address	Contents
OFF 8	
OFF 8	
OFF 9	
OFF A	
OFF B	
OFF C	
OFF D	
OFF E	O B
OFF F	C A
1000	

SP	OFFE

Fig.1. The stack area with the contents of the HL register pair PUSHed in.

Looking at the stack the contents of the H register now appear in location OFFF and the L register in location OFFE. The Stack Pointer now indicates the bottom of the stack at address OFFE. If we now operate on a new instruction, PUSH BC where BC contains 'DCA0', we can further examine the stack to see what has happened.

Address	Contents	
OFF8		
OFF9		
OFFA		
OFFB		
OFFC	D C	Contents
OFFD	A 0	of BC
OFFE	0 B	Contents
OFFF	CA	of HL
1000		

SP	OFFC

Fig.2. The same stack area after a second register pair has been PUSHed. Note that the contents have all been moved.

First the Stack Pointer is pushed down the stack two places and the contents of register BC transferred to it. As a result the stack grows downwards, so it is important to reserve enough memory locations for it when writing a program.

The POP instructions will recover the contents from the stack, *but only in the reverse order that they were entered.* If we now wish to recover the contents of the BC register a simple POP BC instruction will revert us to the position shown in Fig.1. But to recover the HL register pair from Fig.2 is not so straightforward. A simple POP HL will put the contents of BC into register HL. A further POP HL will put the HL contents where they belong, but the 'BC contents' will have been lost. It is, therefore, of the utmost importance that the order of PUSH and POP instructions are carefully studied when writing programs. The stack is a very powerful tool when used wisely but it can create some awful problems if allowed to get out of control.

Further consideration will be given to the stack when discussing subroutines.

Arithmetic And Logic Instructions

This is one of the areas where CPU devices differ, offering better facilities on each new design. Up until the advent of the 6809 and 8086 the arithmetic department was limited to 'add' and 'subtract' operations, but these new devices include limited multiplication and/or division instructions.

All arithmetic and logic processes involve the use of the 'decision' area of a CPU and will set and reset 'bits' in the flag register (F) as shown below :–

Result Zero	Zero flag set
Result goes through Zero to 'FF' and beyond	Set carry flag
Result goes from 'FF' through Zero to '01' and beyond	Set carry flag

The more common logic functions are the AND, OR, the EXCLUSIVE OR (XOR), and are strictly speaking 'bit' operations in that they compare each 'bit' in the register and react accordingly.

AND

A	B	Result
0	0	0
0	1	0
1	0	0
1	1	1

Fig.3. The AND function truth table.

A typical use for the AND logic function is to strip an ASCII code of its ASCII prefix. Take, for example, the ASCII code for a '8' i.e. '38'. If we do a logic AND on '38' with '0F' Hex the result will be '8'.

ASCII	38	0 0 1 1 1 0 0 0
Hex	0F	0 0 0 0 1 1 1 1
		0 0 0 0 1 0 0 0

So taking each column in turn a '1' output will only result when both the ASCII bit and the Hex bit are '1'. By setting the four MSBs of the Hex code to '0000' the result can never be '1'. By setting the 4 LSBs to '1111' the result will mirror the four LSBs of the ASCII code. The result is the value of the ASCII code with its ASCII prefix (30) stripped.

OR

A	B	Result
0	0	0
0	1	1
1	0	1
1	1	1

Fig.4. The OR function truth table.

The OR function can be used for setting a number of bits in a register to a predetermined state. For instance if REG E were to be used as a flag register and was preset to '2A' Hex, bits 6, 4 and D can be set by Register E being OR functioned with '51' Hex.

	B2 ← B0
Reg E (2A Hex)	00101010
OR 51 Hex	01010001
	01111011

Taking each column in turn here, the result will be set to '1' if either bit is set to '1'. So the required bits 6, 4 and 2 have been set to '1' without altering the status of bits 7, 5, 4, 3 or 1.

The exclusive OR function is useful and is frequently used to set the Accumulator to Zero without altering the condition flags. The truth table of the XOR is shown below :–

XOR

A	B	Result
0	0	0
0	1	1
1	0	1
1	1	0

Fig.5. The exclusive OR (XOR) truth table.

To put this function in words, the result is set to '0' only if all bits in that order are the same.

So taking an example, if Reg A (Acc) = 'C4' Hex an exclusive XOR A with A instruction will result in zero.

Reg A	1 1 0 0 1 0 0 0
Reg A	1 1 0 0 1 0 0 0
	0 0 0 0 0 0 0 0

Taking each order of bits they are always the same, so the result will be zero. This is a simple one byte instruction for clearing the accumulator, and does not effect the zero or carry bits in the flag register.

These are by no means all the uses that logic functions can be put to, for a more detailed explanation of truth table and logic functions see Ian Sinclair's series of articles 'Microprocessors By Experiment' in CT, October 1979 issue.

ADD and SUB

The ADD and SUB instructions are self explanatory, except for stating that when an addition results in an overflow, the carry bit is set. Similarly, when a subtraction results in an underflow the carry bit is set. This enables the 'ADD with Carry' and 'SUB with Carry' instructions to take into account the result of a previous arithmetic process.

Increment and Decrement

These instructions are also self explanatory, setting the zero flag when the result is zero.

COMPARE

This is the last instruction of the group and one of the most

commonly used. A compare instruction functions as a phantom 'SUBTRACT', setting all the flags as though the subtraction had taken place, but without modifying any register contents.

e.g. Compare accumulator set to '46' Hex with
Reg B set to '80' Hex

After comparison the CARRY bit will be set, the accumulator will be '46' Hex and register B '80' Hex.

Jump And Subroutine Instructions

In part 1 flags were dealt with in detail and it was stated that these were used for decision making. The decisions are made with Jump and Subroutine instructions.

Take, for example, a simple library of actions which might be listed on the display as follows :–

1. Display 'Example'
2. WAIT 2 secs.
3. Clear the CRT
4. END

Enter your choice :–

To choose, a '1', '2', '3' or '4' is entered from the keyboard. On receipt of the choice the program must decide which option is required. One way would be to use CONDITIONAL JUMP instructions, as shown in the flowchart, Fig.6.

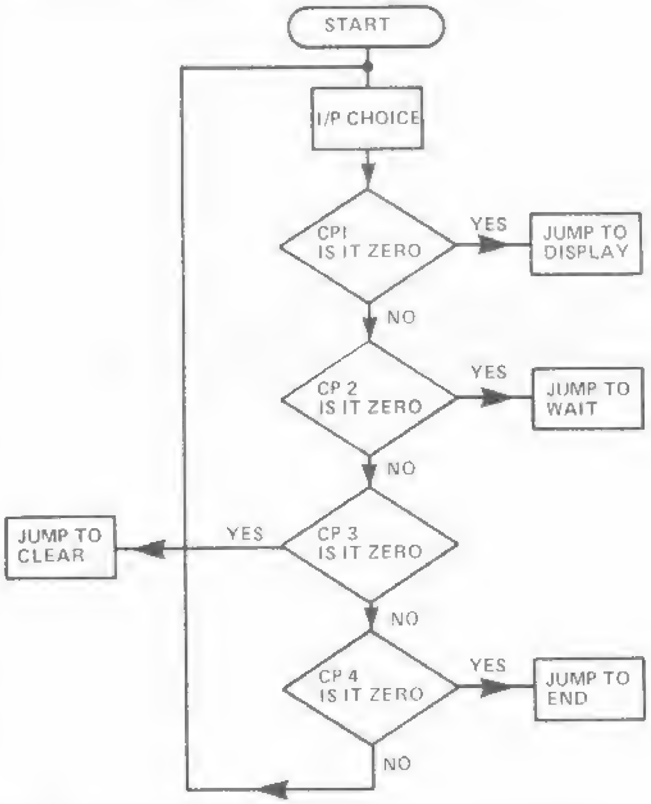


Fig.6. Flowchart showing conditional jumps.

The first decision box, symbolised as a diamond, first *compares* the input with '1'. If the ZERO flag is set then the answer to the question 'Is it Zero' will be 'yes' and a jump can be made to the 'Display' routine. The decision and the jump operations are combined in a single 'JUMP IF ZERO' instruction. If the answer was 'NO' because it was '2', '3' or '4' that was keyed, then the jump part of the instruction would be omitted. This would in our example be repeated for 'Is it 2', 'Is it 3' and 'Is it 4'.

Typical jump instructions are :–

Jump if Zero
Jump if Not Zero (i.e. Z Flag not set)
Jump if Carry
Jump if No Carry (i.e. C Flag not set)
Jump if Parity Odd (i.e. Parity Flag is not set)
Jump if Parity EVEN (i.e. Parity Flag set)
Jump if Sign NEG (i.e. Bit 7 is 1)
Jump if Sign POS (i.e. Bit 7 is zero)
Jump UNCONDITIONAL (Jump irrespective of flags)

The subroutine instructions follow a similar pattern. If any of the above conditions are encountered, then a call can be made to a separate part of the program designated to carry out a particular function.

For example, if a program is counting the days of the week, when it encounters '8' it should be reset to 1.

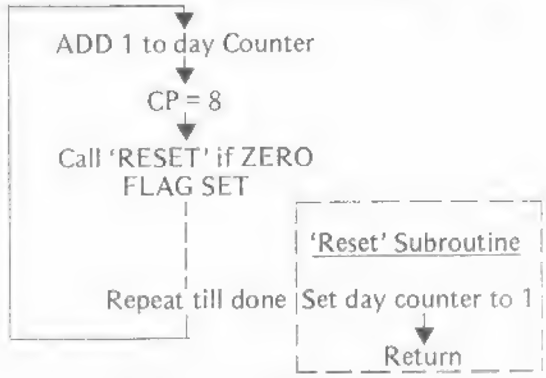


Fig.7. Jumping to a subroutine on a conditional.

As for the condition subroutine call instructions, so too are there conditional subroutine return instructions. We will return (no pun intended) to subroutines later when discussing program structure. Note that all subroutine instructions make use of the stack to store return addresses.

One last point on jump and subroutines is the relative jumps and subroutines offered by some CPU and/or monitors. Here, instead of the 3 byte absolute instructions specifying the literal address the jump or 'call' has to be made to, an offset figure is given 'relative' to the location address of the jump instruction. These can be both forward or backward and up to 7F Hex bytes distant. Table 1 gives a tabulated guide for relative jumps and calls. One advantage of such instructions is that a section of program containing relative jumps can be 're-located' without having to change any address data.

Bit Manipulation Instructions

So far consideration has only been given to instructions which operate on 1 or 2 bytes (i.e. 8 or 16 bits) of data held within a register or register pair. The flexibility of most CPU's is further increased by the ability to operate on individual bits within a register. The Zilog Z80 CPU has a very extensive bit manipulation group which can test, set or reset any bit in any register, but most other CPU's are limited to ROTATE AND SHIFT instructions.

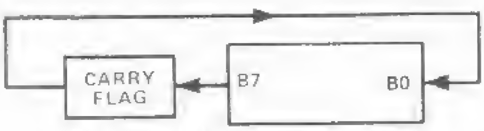


Fig.8. Rotate left through carry.

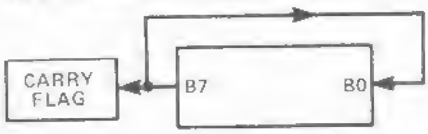


Fig.9. As Fig.8 but without a carry.

There are two types of rotate instruction, those that rotate *through* the carry flag and those that affect the carry but do not rotate through it. See Figs.8 and 9 respectively. Although these show rotation in a 'LEFT' direction, rotation in 'RIGHT' direction can also take place. On a rotate 'LEFT' instruction in Fig.8, Bit 7 will be passed into the carry flag which will be set if B7 has been '1' and reset if bit 7 had been '0'. The original contents of the carry flag will be passed into bit 0 and all other bits will move along one place.

One usage of this is in mathematical division of binary numbers. To divide a binary number by 2 or 4 the number need only be moved RIGHT one or two places respectively. So to test if a number is divisible by '4' without destroying the original number the following algorithm could be used.

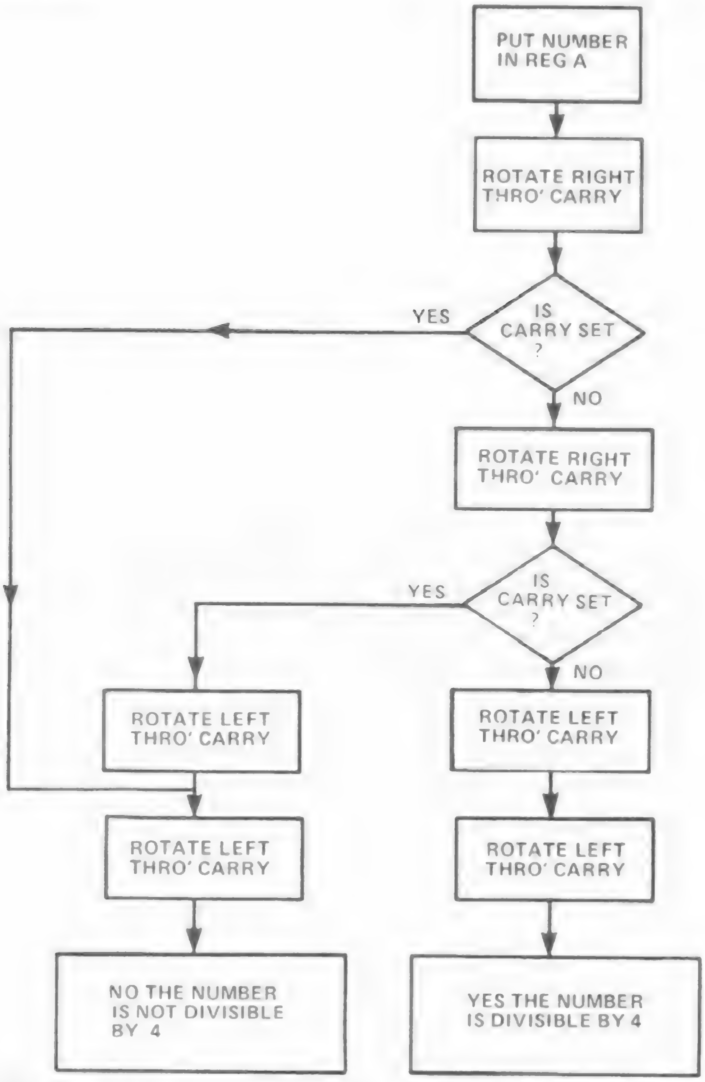


Fig.10. An algorithm to see if a binary number is divisible by 4.

Shift instructions differ from Rotate instructions in one respect only. Any 'bit' shifted out of a register at either end is lost. The vacancy at the other end normally being filled by a '0'. This technique is commonly used when a byte of data (8 bits) requires displaying on a CRT as two ASCII characters.

For more detailed explanation on the variants of these instructions consult the CPU operating manuals.

Bit Test, Set And Reset

This is a very powerful set of instructions and can be very effectively put to use where the CPU is being used as an external device controller.

Some typical applications are given below :–

1. Flags can be set or reset in a dedicated 'Flag' memory location or register.
2. Having obtained a Random Number, individual bits can be tested to preset 'options'.
3. When data is input from a port, that data can be analysed by bit test instructions e.g. If a port is being used to monitor the progress of a train on a model railway, several monitoring positions can be set around the track and allocated a bit in the PORT as a window, see Fig.11.

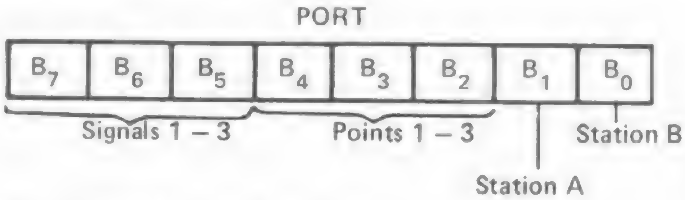


Fig.11. Analysing an input port's data.

If, for instance, you wanted to stop the train at station A, the program could sit in a holding loop monitoring Bit 1. When Bit 1 is detected as set it is known that the train is at that location and can be halted under program control.

4. External equipment can be switched by setting specific bits in a O/P Port. Continuing with the example shown in Fig.11 setting Bit 3, point 2 can be operated, by resetting B3 that point can be released.

Input And Output Instructions

Ports are often required when the CPU is to be interfaced with what we call Peripheral Equipment. i.e. Printers, Readers, Keyboards or any machinery that is to be controlled or observed. There are three main types of port, Non latching, Latching and Programmable Input/Output.

Non Latching:– A non latching port is of limited use because it requires separate decoding from the address bus and has to have the data available when the CPU requests it.

Latching:– This is more commonly used and the decoding is normally carried out within the system hardware. Here data can be either passed to the port for storage until required by the peripherals, or conversely will input data from a peripheral and store it until the CPU is ready to act on it. This technique is usually used for keyboard controllers etc.

Programmable input/output ports (PIA or PIO):– These can be very complex devices and the manufacturers application information must be carefully studied. In brief these devices can be programmed by software as input ports or output ports or a mixture of both simultaneously. Any data sent to a designated output port will be retained there until updated. A designated input port will also latch any input data but has the additional facility of INTERRUPT. Any bit or bits in the port can be continuously monitored by the port and any change of state will signal to the CPU that action is required. The interrupt instructions are all associated with this operation. Any further discussion on interrupt techniques is outside the scope of the beginner and therefore not appropriate to this article.

Restart Instructions

Built into the CPU architecture is a facility known as RESTARTS. Typically there are eight of these and they can be likened to subroutine call instructions, but are only *one byte*

in length. These are provided so the commonly used subroutines; such as INPUT, OUTPUT to CRT, STRING and DELAY can be accessed simply and economically from the program.

Miscellaneous Instructions

The most common miscellaneous instructions are listed below with comments.

NO OPERATION:	The CPU ignores this instruction, but takes time to do it. It is useful for leaving gaps for later modification, deleting an unwanted instruction or as a delay in a timing circuit.
HALT:	Arrests the operation of the program. The only way out is via the system RESET key.
DECIMAL ADJUST:	A very useful instruction as it permits a degree of decimal arithmetic on the Hexadecimal machine. e.g. after incrementing the A register from '09' to '0A' Hex the decimal adjust instruction will correct the result to '10'
COMPLEMENT:	The complement instruction will invert all bits in the accumulator. e.g. After a complement instruction 01001110 will become 10110001.
2's COMPLEMENT:	This is a special instruction included in some CPU's to ease binary division problems. After the '2's Complement' instructions 01001110 will become 10110010 i.e. the complement plus '1'.
COMPLEMENT CARRY FLAG : SET CARRY FLAG:	These are self explanatory

Index Addressing

The concept of indexed addressing seems to cause more confusion than anything else to the novice programmer, yet with thought and practice it can be developed as one of the most flexible and powerful of all operating modes.

Instead of a 16 bit register pair containing data to be operated on, it holds the 16 bit address of a memory location.

For example the Index Register may contain the address 'BFC4' which is part of a Jump instruction as shown in Fig.12.

ADDRESS	DATA
BFC2	NOP
BFC3	JUMP
BFC4	E4
BFC5	0D
BFC6	HALT

Fig.12. A section of machine code from BFC2 to BFC6.

A typical index instruction might be 'Put 'DC' Hex into the location whose address is in the INDEX REGISTER.

In our example the data in location BFC4 would change from 'E4' Hex to 'DC' Hex, and would at some later stage in the program cause a jump to address '0DDC' instead of '0DE4'. In this way a program can be organised so as to change itself as it progresses.

Similarly, indexing can be used to load into the A register the contents of the memory location addressing in the Index Register.

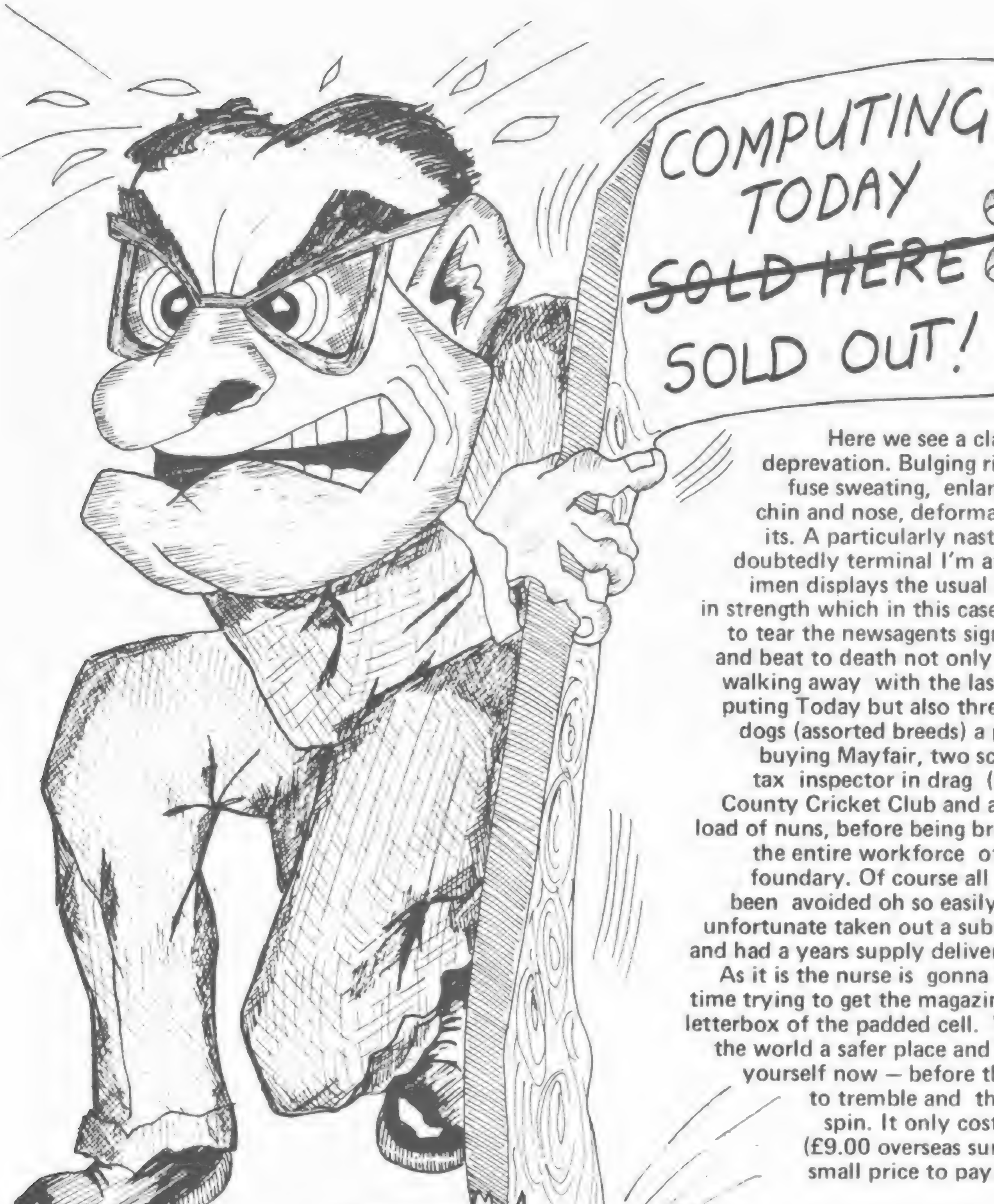
Some Index registers have an 'OFFSET' capability whereby the Index register can contain, for example, the starting address of a table. To access the 5th position in that table the instruction would be:– 'Load into Register A the contents of the memory location 5 in advance of the address in the Index Register'.

Next month we will take a look at the function of system monitors and the facilities that they can offer. Also a start will be made in putting together a real program.

Table 1. This chart gives the hexadecimal offset that has to be entered into the program to achieve a jump that corresponds to the decimal separation indicated on the axis.

	0	1	2	3	4	5	6	7	8	9
120	76	77	78	79	7A	7B	7C	7D	7E	7F
110	6C	6D	6E	6F	70	71	72	73	74	75
100	62	63	64	65	66	67	68	69	6A	6B
90	58	59	5A	5B	5C	5D	5E	5F	60	61
80	4E	4F	50	51	52	53	54	55	56	57
70	44	45	46	47	48	49	4A	4B	4C	4D
60	3A	3B	3C	3D	3E	3F	40	41	42	43
50	30	31	32	33	34	35	36	37	38	39
40	26	27	28	29	2A	2B	2C	2D	2E	2F
30	1C	1D	1E	1F	20	21	22	23	24	25
20	12	13	14	15	16	17	18	19	1A	1B
10	08	09	0A	0B	0C	0D	0E	0F	10	11
0				01	02	03	04	05	06	07
0		FD	FC	FB	FA	F9	F8	F7	F6	F5
10	F4	F3	F2	F1	F0	EF	EE	ED	EC	EB
20	EA	E9	E8	E7	E6	E5	E4	E3	E2	E1
30	E0	DF	DE	DD	DC	DB	DA	D9	D8	D7
40	D6	D5	D4	D3	D2	D1	D0	CF	CE	CD
50	CC	CB	CA	C9	C8	C7	C6	C5	C4	C3
60	C2	C1	C0	BF	BE	BD	BC	BB	BA	B9
70	B8	B7	B6	B5	B4	B3	B2	B1	B0	AF
80	AE	AD	AC	AB	AA	A9	A8	A7	A6	A5
90	A4	A3	A2	A1	A0	9F	9E	9D	9C	9B
100	9A	99	98	97	96	95	94	93	92	91
110	90	8F	8E	8D	8C	8B	8A	89	88	87
120	86	85	84	83	82	81	80			

ARRRGGGHHH.....



Here we see a classic case of CT deprevation. Bulging ringed eyes, profuse sweating, enlargement of the chin and nose, deformation of the digits. A particularly nasty case this. Undoubtedly terminal I'm afraid. The specimen displays the usual manic increase in strength which in this case was employed to tear the newsagents sign from its roots and beat to death not only the gentleman walking away with the last copy of Computing Today but also three grannies, five dogs (assorted breeds) a police informer buying Mayfair, two schoolchildren, a tax inspector in drag (OBE) half the County Cricket Club and a passing coach load of nuns, before being brought down by the entire workforce of the local iron foundary. Of course all this could have been avoided oh so easily had the poor unfortunate taken out a subscription to CT and had a years supply delivered to his door. As it is the nurse is gonna have a hell of a time trying to get the magazines through the letterbox of the padded cell. Why not make the world a safer place and take out a sub yourself now — before the hands begin to tremble and the eyes begin to spin. It only costs £8.00 a year (£9.00 overseas surface mail) — a small price to pay.

Computing Today
Subscriptions Dept.,

M.A.P. PO Box 35,
Bridge Street,
Hemel Hempstead,
Hertfordshire.

Elaine Douse

Discover where your money goes and how much your car really costs you with this accounting package.

This program evolved from a need to record the fuel consumption of a vehicle. On acquiring a moped, the author then required that the same program would cope with the differing sets of figures that the vehicles would provide. The first, and most important point, was that the scales of the histograms produced would not be cramped by being fixed. This program sets its own scales depending on the maximum and minimum figures that are to be plotted and will now cope with any vehicle from a moped to a juggernaut!

Petrol In The Tank

Fuel consumption is best calculated by noting the amount of petrol put into the tank, and, when the tank is filled to the brim, recording the mileage.

The next problem is whether the average fuel figures or the figures at each tank filling stage should be recorded. There are many arguments for both methods, so, to compromise, this program records them both. To help show any small change it is possible to reset the datum point which will clear all variables except the previously recorded graph information.

Running Costs

We only have to add one more figure to our information in order to calculate the running costs and that is the costs of petrol and repairs. The repairs side can be split into three categories, thus :–

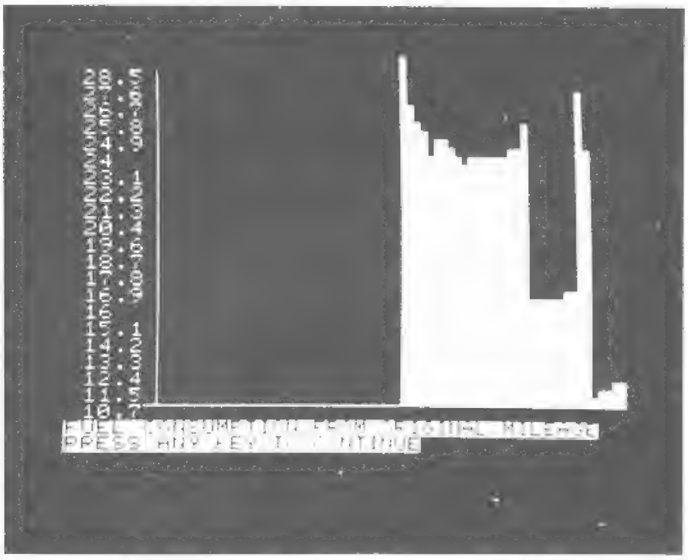
a) Depreciation
b) Servicing
c) Repairs

The depreciation is a difficult figure to program in because it is a highly individual subject. It depends on so many variables that it was thought best left to the individual to input as a repair cost.

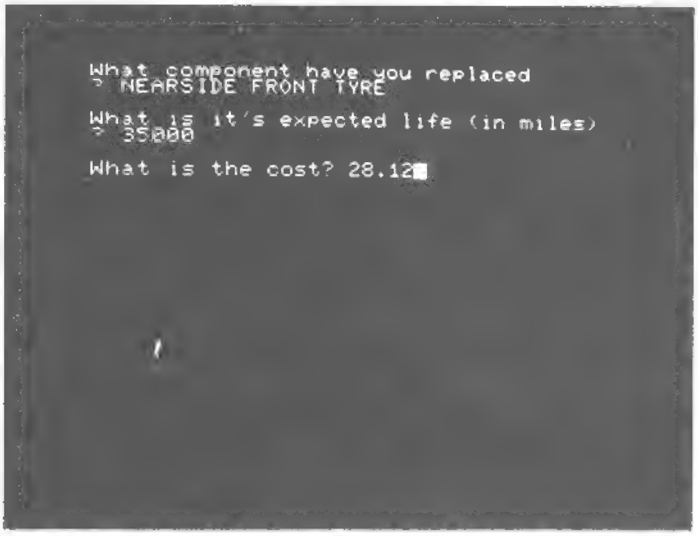
The repairs and servicing are kept separate in order that the computer's 'long memory' can be utilised to give servicing reminders. For example, a windscreen does not have a 'life expectancy' and so would be put in under REPAIRS, whereas a new tyre does have a life and so would be put under SERVICING. There does not have to be any cost involved for service reminders so things like battery check and tyre pressures can be logged into the computer's memory.

When one is finished with the refuelling part of the program an automatic search is made to see if the last recorded mileage figure is close to the end of a component's life. One also has the option of losing or keeping any reminders that are encountered, in case one cannot deal with a particular problem at that particular time but want to be reminded later on.

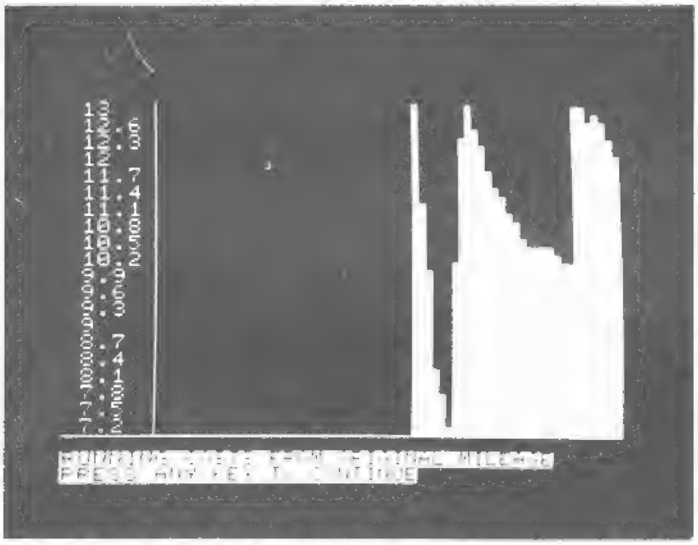
MOTORING FINANCE



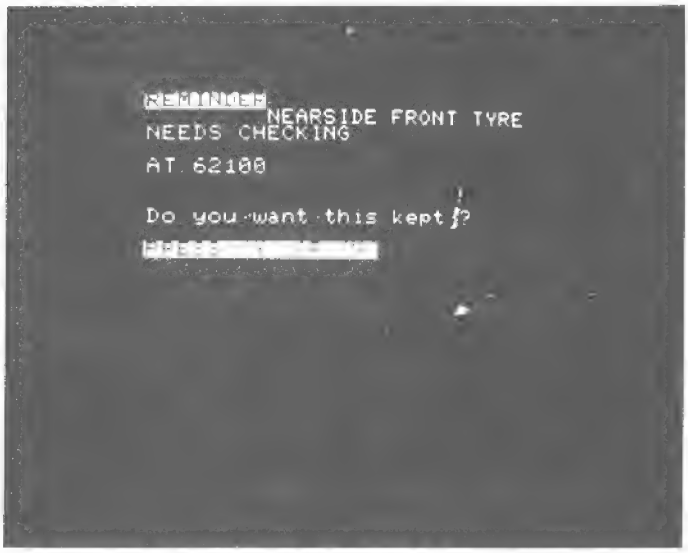
A partly filled graphic display of running costs — note the differing scales.



Now you've replaced that tyre you can enter the costs into the program along with its expected life.



A fuel consumption display with the scales set from min to max.



A tyre may be nearing the end of its life so you get a service reminder.

The Program Listing

The program is listed for the Commodore PET using the following abbreviations :

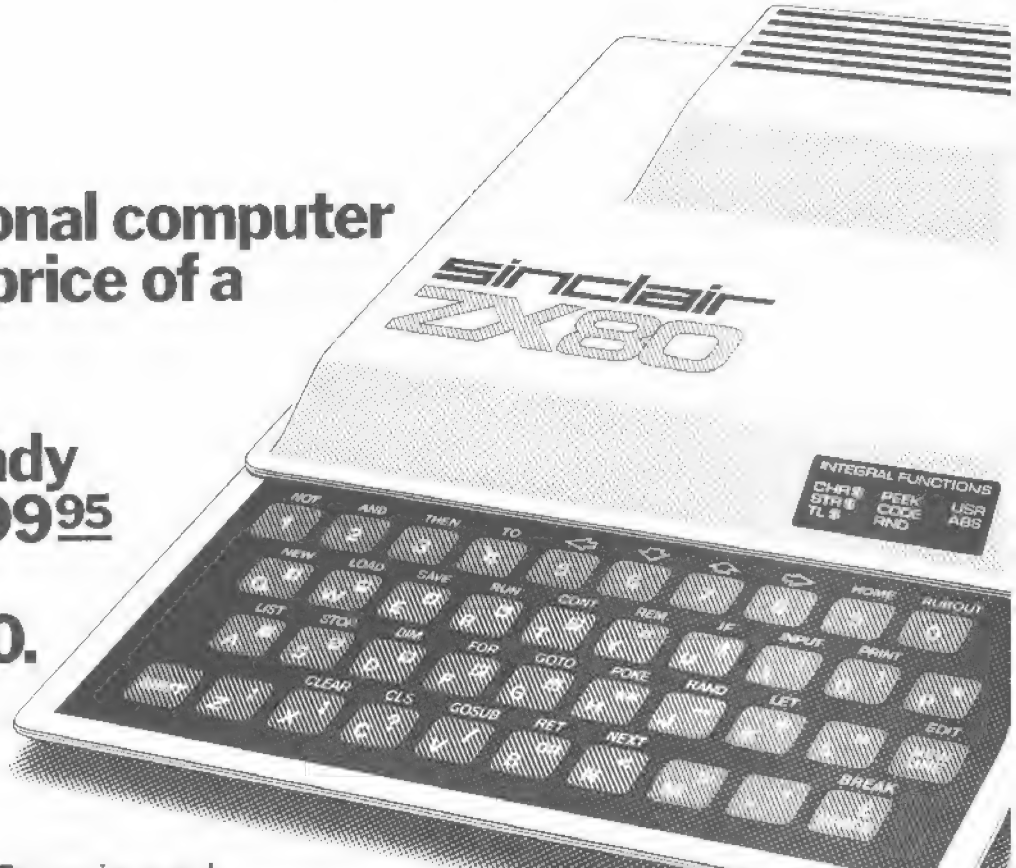
?	Pet shorthand for PRINT onto VDU
[CLR]	Clear screen, put cursor in top left hand corner
[CD]	Cursor down
[CU]	Cursor up
=	Hash when in conjunction with PRINT to file number
≠	Not equal to when in an IF statement
[HOME]	Put cursor to top left of screen
[REV]	Reverse graphics on
[REV OFF]	Reverse graphics off

```
10  INPUT"[CLR] NAME PLEASE";A$
20  IFA$#"[PASSWORD]"THEN NEW
25  POKE 59468, 14
30  DIM RC %(66),FC %(66),FT %(66),RM(100),RM$
    (100)
40  INPUT"[CD] Is this a first run";A$
50  INPUT"[CD] Vehicle registration";CR$
60  IF LEFT$(A$,1)="Y" THEN 190
62  ?"[CD] INSERT [REV]"CR$"[REV OFF] [SPACE]
    DATA TAPE AND
64  ?"[CD] FULLY REWIND
66  GOSUB 750
70  OPEN 1,1,0,CR$
75  ?"[CD] FILE "CR$" [SPACE] FOUND
80  FOR I=1 TO 66:INPUT#1,RC %(I):NEXT
85  FOR I=1 TO 66:INPUT#1,FC %(I):NEXT
90  FOR I=1 TO 66:INPUT#1,FT %(I):NEXT
95  I=0
100 INPUT#1,RM(I):IF RM(I)=999 THEN 115
105 INPUT#1,RM$(I)
```

```
110  I=I+1:GOTO 100
115  RM(I)=0:INPUT#1,F
120  INPUT#1,F1
125  INPUT#1,PC
130  INPUT#1,M
135  INPUT#1,M1
140  INPUT#1,M2
145  INPUT#1,C
146  INPUT#1,C1
147  INPUT#1,C2
150  CLOSE 1
160  ?"[CLR] THE RECORDS ARE LOADED FOR
     "CR$
170  ?"[CD] MILEAGE AT LAST UPDATE WAS"M2
180  GOSUB 750:GOTO 200
190  INPUT"[CD] Original mileage please";M
195  M1=M: M2=M: C=0: C1=0: C2=0: F=0: F1=0
200  ?"[CLR] MOTORING COSTS by Elaine Douse
210  ?TAB(5)"[CD] 1. REFUELLING
220  ?TAB(5)"[CD] 2. REPAIRS
230  ?TAB(5)"[CD] 3. SPARE PARTS AND SERVICING
240  ?TAB(5)"[CD] 4. CONSUMPTION TANK TO TANK
250  ?TAB(5)"[CD] 5. RUNNING FUEL CONSUMPTION
260  ?TAB(5)"[CD] 6. RUNNING COSTS FROM START
270  ?TAB(5)"[CD] 7. SERVICE REMINDERS
280  ?TAB(5)"[CD] 8. JOURNEY COSTS
290  ?TAB(5)"[CD] 9. TAPE UPDATE
295  ?TAB(4)"[CD] 10. NEW MILEAGE DATUM
300  INPUT"[3xCD] Which section do you require";A
310  IF A#INT(A) OR A > 10 OR A < 1 THEN 200
315  P=33654
320  ON A GOTO 1000, 2000, 3000, 4000, 5000, 6000,
     7000, 8000, 9000, 190
750  ?"[CD] [REV] PRESS ANY KEY TO CONTINUE":
     GOTO 810
800  ?"[CD] [REV] PRESS 'Y' OR 'N'
810  GET A$:IF A$=" "THEN 810
820  RETURN
1000 ?"[CLR] Is this a tankfull?
1010 GOSUB 800
1020 IF A$="N" THEN 1200
1030 FOR I=1 TO 65:FC%(I)=FC%(I+1):FT%(I)=FT
     %(I+1):RC%(I)=RC%(I+1):NEXT
1040 GOSUB 1800
1050 FC%(66)=((M2-M1)/F1)*10
1060 FT%(66)=((M2-M)/(F+F1))*10
1070 RC%(66)=(C/(M2-M))*10
1080 M1=M2:F=F+F1:F1=0:C2=0:C1=0
1090 ?"[CLR] Here are the latest computations:-
1100 ?"[CD] Fuel consumption tank to tank":? FC
     %(66)/10"mpg ("FC%(65)/10")
1110 ?"[CD] Average fuel consumption":? FT%(66)/
     10"mpg ("FT%(65)/10")
1120 ?"[CD] Running costs":?RC%(66)/10"ppm ("RC
     %(65)/10")
1125 ?"[CD] Fuel costs are"PC" pounds per gallon
1130 ?"[2xCD] HAVE YOU ANY MORE INPUTS
1140 GOSUB 800
1150 IF A$="Y" THEN 1000
1160 GOTO 7000
1200 GOSUB 1820:GOTO 1130
1800 ?"Last mileage recorded was "M2
1810 INPUT"[CD] What was the mileage";M2
1820 INPUT"[CD] How many gallons";F2:F1=F1+F2
1840 INPUT"[CD] What was the cost of the fuel";C2:
     C2=C2*100:C=C+C2+C1
1850 PC=INT(C2/F1+.005)/100:RETURN
2000 ?"[CLR]
2010 INPUT"What was the cost of the repairs";A
2020 C1=C1+(A*100)
2030 ?"[2xCD] HAVE YOU ANY MORE REPAIRS
2040 GOSUB 800:IF A$="Y" THEN 2000
2050 GOTO 200
3000 IF FRE(0) < 35 THEN 3030
3020 FOR I=0 TO 100:IF RM(I)=0 THEN 3100
3030 ?"[CLR] [REV] SORRY NO ROOM AT PRESENT
     I WILL MOVE
3040 ?"[CD] [REV] YOU TO ANOTHER PART OF THE
     PROGRAM
3050 FOR I=1 TO 2000:NEXT:GOTO 6000
3100 ?"[CLR] What component have you replaced
3105 INPUT RM$(I)
3110 ?"[CD] What is its expected life (in miles)
3115 INPUT A
3120 RM(I)=A+M2
3130 INPUT"[CD] What is the cost";A:C1=C1+(A*100)
3150 ?"[CD] Have you any more items?
3160 GOSUB 800
3170 IF A$="Y" THEN 3000
3180 GOTO 200
4000 POKE 59468, 12:?"[CLR]":MI=9999
4005 FOR I=1 TO 66:IF FC%(I)=0 THEN 4020
4006 IF FC%(I) < MA THEN 4020
4010 MA=FC%(I)
4020 IF FC%(I) > MI THEN 4028
4022 MI=FC%(I)
4028 NEXT:X=(MA-MI)/40
4030 GOSUB 10000:GOSUB 11000
4040 ?"[REV] FUEL CONSUMPTION TANK TO TANK
     [CU]
4050 GOSUB 12000
4060 FOR I=1 TO 65 STEP 2
4070 A=FC%(I):B=FC%(I+1)
4080 GOSUB 13000:NEXT
4090 GOSUB 11000:GOSUB 750:MA=0:POKE 59468,14:
     GOTO 200
5000 POKE 59468, 12:?"[CLR]":MI=9999
5005 FOR I=1 TO 66:IF FT%(I)=0 THEN 5028
5006 IF FT%(I) < MA THEN 5020
5010 MA=FT%(I)
5020 IF FT%(I) > MI THEN 5028
5022 MI=FT%(I)
5028 NEXT:X=(MA-MI)/40
5030 GOSUB 10000:GOSUB 11000
5040 ?"[REV] FUEL CONSUMPTION FROM ORIGINAL
     MILEAGE [CU]
5050 GOSUB 12000
5060 FOR I=1 TO 65 STEP 2
5070 A=FT%(I):B=FT%(I+1)
5080 GOSUB 13000:NEXT
```

```
5090  GOSUB 11000:GOSUB 750:MA=0:POKE 59468,14:
      GOTO 200
6000  POKE 59468, 12:?"[CLR]":MI=9999
6005  FOR I=1 TO 66:IF RC %(I)=0 THEN 6028
6006  IF RC %(I) < MA THEN 6020
6010  MA=RC %(I)
6020  IF RC %(I) > MI THEN 6028
6022  MI=RC %(I)
6028  NEXT:X=(MA–MI)/40
6030  GOSUB 10000:GOSUB 11000
6040  ?"[REV] RUNNING COSTS FROM ORIGINAL
      MILEAGE [CU]
6050  GOSUB 12000:
6060  FOR I=1 TO 65 STEP 2
6070  A=RC %(I):B=RC %(I+1)
6080  GOSUB 13000:NEXT
6090  GOSUB 11000:GOSUB 750:MA=0:POKE 59468,14:
      GOTO 200
7000  ?"[CLR]
7005  ?"I am looking for service reminders
7010  FOR I=1 TO 2000:NEXT
7020  FOR I=0 TO 100
7030  IF RM(I)=0 THEN 7060
7040  IF RM(I) < M2+200 THEN 7100
7060  NEXT
7080  ?"[CD] Search is complete":GOSUB 750:GOTO 200
7100  ?"[CD] [REV] REMINDER [REV OFF] [CD] "RM$
      (I):?"NEEDS CHECKING
7120  ?"[CD] AT"RM(I)
7140  ?"[2xCD] Do you want this kept?
7160  GOSUB 800
7180  IF A$="Y" THEN 7060
7200  RM$(I)=" ":RM(I)=0:GOTO 7060
8000  ?"[CLR] Is this a British (B) or a continental (C)
      journey
8002  INPUT A$:IF A$="B" THEN 8005
8004  INPUT"[2xCD] What is the fuel cost (per gall)";PC
8005  INPUT"[CD] length of journey";M9
8010  ?"[2xCD] With petrol at "PC" pounds per gallon
8020  ?"[2xCD] the cost of this journey will be as":?"
      follows:–
8040  Z=PC*(M9/FT %(66)*10):Y=RC %(66)*10*M9–Z
8060  ?"[2xCD] Fuel cost will be "INT(Z*100)/100"
      pounds
8080  ?"[2xCD] Fuel used will be "INT(M9/FT %(66)*M9/
      10)/100" pounds
8120  ?"[2xCD] Journey will cost "INT(RC %(66)*M9/
      10)/100" pounds
8200  ?"[3xCD]":GOSUB 750:GOTO 200
9000  PRINT"[CLR] FULLY REWIND "CR$" DATA
      TAPE
9005  A=1:GOSUB 750:POKE 244,2:POKE 243,122
9010  OPEN1,1,1,CR$
9020  FOR I=1 TO 66:PRINT#1,RC %(I):GOSUB 9400:
      NEXT
9040  FOR I=1 TO 66:PRINT#1,FC %(I):GOSUB 9400:
      NEXT
9060  FOR I=1 TO 66:PRINT#1,FT %(I):GOSUB 9400:
      NEXT
9080  FOR I=0 TO 30:IF RM %(I)=0 THEN 9140
9100  PRINT#1,RM(I):GOSUB 9400
9120  PRINT#1,RM$(I):GOSUB 9400
9140  NEXT:PRINT#1,"999":GOSUB 9400
9160  PRINT#1,F:GOSUB 9400
9180  PRINT#1,F1
9200  PRINT#1,PC:GOSUB 9400
9220  PRINT#1,M
9240  PRINT#1,M1:GOSUB 9400
9260  PRINT#1,M2
9280  PRINT#1,C:GOSUB 9400
9281  PRINT#1,C1
9282  PRINT#1,C2:GOSUB 9400
9300  CLOSE 1
9320  IF A=0 THEN 9360
9340  A=0:GOTO 9010
9360  PRINT"[REV] GOOD BYE":END
9400  IF PEEK(625) < 180 THEN RETURN
9410  POKE 59411,53:T=T1
9420  IF TI–T < 6 THEN 9420
9430  POKE 59411,61:RETURN
10000 FOR I=1 TO 20
10010 ?"[6xSPACE 1xSHIFTED']":REM VERTICAL
      LINE RIGHT HAND SIDE OF POSITION
10020 NEXT
10030 FOR I=1 TO 40
10040 ?"[SHIFTED HASH]";REM HORIZONTAL LINE
      TOP OF POSITION
10050 NEXT:RETURN
11000 ?"[HOME]":REM TOP LEFT HAND CORNER
      OF SCREEN
11010 FOR I=1 TO 21
11020 ?"[CD]";:NEXT
11030 RETURN
12000 ?"[HOME]
12010 FOR I=MA TO MI STEP–2*X
12020 ?INT(I)/10
12030 NEXT:RETURN
13000 P=P+1:V=–40
13010 FOR J=MI TO MA STEP 2*X
13020 V=V–40
13030 IF A > J AND B > J THEN 13190
13040 IF A > J–X AND B > J THEN 13180
13050 IF A > J AND B > J–X THEN 13170
13060 IF A > J THEN 13160
13070 IF B > J THEN 13150
13080 IF A > J–X AND B > J–X THEN 13140
13090 IF A > J–X THEN 13130
13100 IF B > J–X THEN 13120
13110 GOTO 13210
13120 POKE P+V,108:GOTO 13210
13130 POKE P+V,123:GOTO 13210
13140 POKE P+V,98:GOTO 13210
13150 POKE P+V,225:GOTO 13200
13160 POKE P+V,97:GOTO 13200
13170 POKE P+V,252:GOTO 13200
13180 POKE P+V,254:GOTO 13200
13190 POKE P+V,160
13200 NEXT J
13210 RETURN
```

Britain's first comp



A <u>complete</u> personal computer for a third of the price of a bare board.

Also available ready assembled for £99.95

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Until now, building your own computer could easily cost around £300 – and still leave you with only a bare board for your trouble.

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- FREE course in BASIC programming and user manual.

Optional extras

- Mains adaptor of 600 mA at 9 V DC nominal unregulated (available separately – see coupon).
- Additional memory expansion boards allowing up to 16K bytes RAM. (Extra RAM chips also available – see coupon.

*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired (see coupon).

Two unique and valuable components of the Sinclair ZX80.

The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter... offers remarkable programming advantages:

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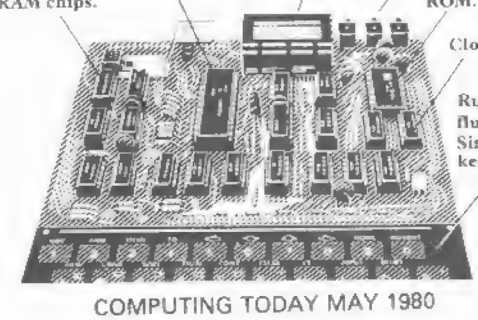
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them
- Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input – to request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control
- PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols
- All characters printable in reverse under program control.
- Lines of unlimited length.

...and the Sinclair teach-yourself BASIC manual.

If the features of the Sinclair interpreter listed alongside mean little to you – don't worry They're all explained in the specially-written 128-page book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs. Available separately – purchase price refunded if you buy a ZX80 later.

A hardware manual is also included with every kit or built machine.



plete computer kit.

Fewer chips, compact design, volume production – more power per pound!

The ZX80 owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer – typically storing 100 lines of BASIC. Key words occupy only a single byte.

The display shows 32 characters by 24 lines.

And Benchmark tests show that the ZX80 is faster than all other personal computers.

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sinclair ZX80

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	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	99.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	8.95	
	Memory Expansion Board(s) (each one takes up to 3K bytes).	12.00	
	RAM Memory chips – standard 1K bytes capacity.	16.00	
	Sinclair ZX80 Manual(s) (manual free with every ZX80 kit or ready-made computer).	5.00	
NB. Your Sinclair ZX80 may qualify as a business expense.		TOTAL	£

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CT/5/80

Owen Bishop

After light comes sound. Put ears on your micro with our simple sound interface.

This highly sensitive sound-operated interface plugs into the system in the same way as the LED interface described in Part 1. If you are using the Acorn, you can use the same connecting wire and socket. If you are using the Mk-14, you will need to remove the connection to Flag 2 output, and take it to SENSE A input, as explained later.

Circuit Description

The circuit is probably the most elaborate one that we shall be describing in this series, though it is by no means expensive or difficult to build. The main reason for its complexity is the need to amplify the minute currents produced by the microphone. The amplifying circuit consists of Q1, Q2 and Q3 and their associated components. When sound is received, a fluctuating voltage appears at the base of Q3. This is tapped at a suitable level by the wiper of RV1 and fed to Q5. This is the heart of the circuit and is a relatively unusual device called a silicon controlled switch. The main current flows from a to k but only after a high pulse has been received at the cathode gate (gk). So when a sound is received, any slight increase in voltage at gk makes Q5 begin to conduct. This turns D1 on, as an indication that the circuit has been triggered, and also turns Q6 on, causing the output to fall from high (+5 V) to low (0 V). This output is fed directly to the microprocessor system. Once the circuit has been triggered, it remains in this state. To reset it, the current to Q5 must be momentarily interrupted. This is done by turning off Q4. The 'reset' input should normally be high (+5 V), but if it is brought low for an instant, Q4 is turned off. The current through Q5 is reduced below its holding value and, when Q4 is turned on again, no current flows through Q5.

PARTS LIST

Resistors All ¼W, 5%

R1	3M3
R2	820k
R3	39k
R4	10k
R5,9,11,12	1k0
R6	2k7
R7	1k8
R8	100k
R10	180R
RV1	1k0 preset

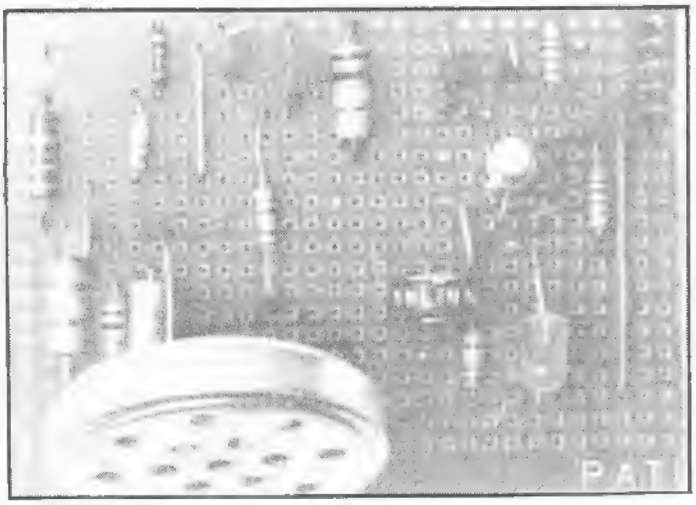
Capacitors

C1	47u electrolytic

Semiconductors

Q1,2,3,4,6	ZTX300
Q5	BRY39
LED1	TIL209

Miscellaneous
Veroboard, crystal microphone insert, 5way PCB plug.



Veroboard layout, compare with Figure 2.

Construction

The circuit board layout is shown in Fig.2, the microphone is a cheap version, sold as a 'microphone insert'. It is supported on two stout connecting wires. If you have a microphone of better quality and can spare it for this task, there is no reason why it should not be used. The microphone can also be mounted and used remotely, if desired. It is best to begin by wiring up the amplifier section, including R6, RV1 and R7. If you then connect a crystal earpiece or headphone

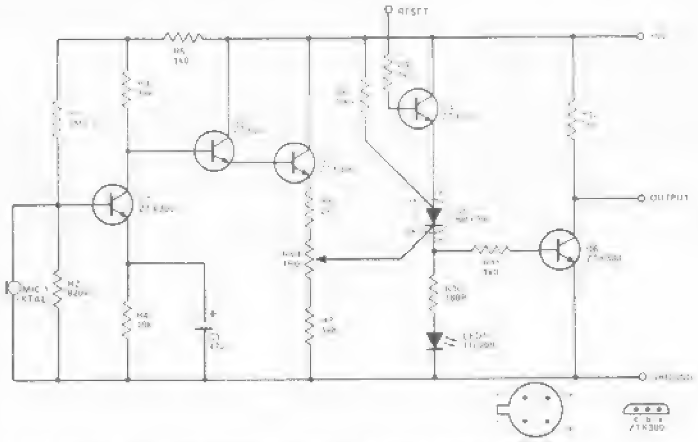
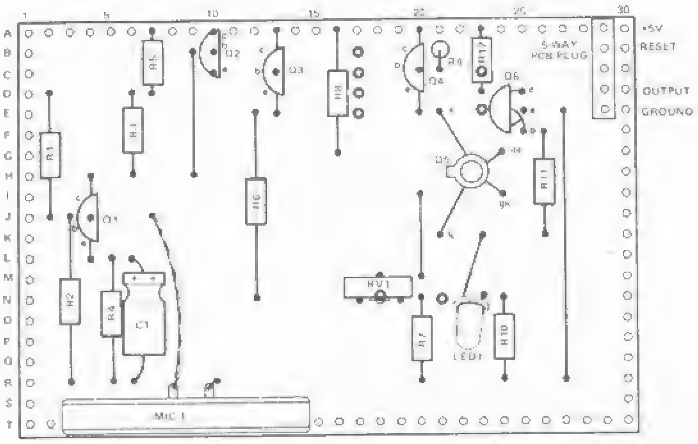


Fig.1. The sound triggered interface circuit diagram.



CUT STRIPS BENEATH BOARD AT B17, C17, D17, E17, C23, E22, N18, N21

Fig.2. Veroboard layout for the circuit.

CT COMPUTING GLOSSARY

A far cry from your 'Hundred Best Tunes'. Our Buzzword guide to the computer vernacular from P.D Reynolds.

A

Address The number, eg 62768, identifying a place in *memory*.

Aluminised (paper) Printer paper surfaced with a thin deposit of metal. The characters are formed by darkening caused by electric current flowing onto the paper from the pins of a matrix print head.

ASCII American Standard Code for Information Interchange – representing letters, numbers etc by the 128 permutations of a 7-bit code.

Assembler Program which converts the low-level mnemonic instructions of assembly language to the binary machine language instructions required to drive a *central processor*.

B

BASIC Beginners' All-purpose Symbolic Instruction Code – a popular high-level programming language developed at Dartmouth College, USA.

Batch (Processing) A method of computer working in which a large number of transactions are grouped together before processing (so that control totals etc can be taken) and which are then passed through the various stages of processing as a group or batch. This was the original method of data processing for commercial work and contrasts with *interactive* and demand processing.

Baud A rate of data transmission commonly, though strictly not correctly, taken as synonymous with bits per second.

BCD Binary Coded Decimal – a 4-bit system for representing the 10 decimal digits.

Benchmark A standard computing task used to measure the relative speeds of different processors.

Binary Numbering system with the base 2, using the digits 0 and 1 instead of the decimal series 0 to 9. All digital computers work on data and instructions presented as binary numbers.

Bit Binary digit (contraction). Must be 0 or 1.

Block A sequence of *data words* or *bytes* treated as a unit, especially when working with magnetic tape.

Data base A system for organising the elements of information in a machine-readable file so that a program can readily select from this data base any particular abstraction or combination of information that may be called for. For instance, a customer data base might include full details of all customers (as required for service and distribution departments as well as sales and marketing) and also of every service call and delivery as well as each item invoiced to these customers during a year or longer. A suitable program could access that data base to answer such questions as "identify the customers buying more than £1,000 of item in less than five deliveries and receiving less than two service calls in the year."

Debug To correct the errors in a program.

Disc (Disk) Magnetic storage device allowing fast random access to any selection from a large volume of *data*. A full-size hard disc will hold say 5 megabytes or more, a smaller *floppy* disc typically holds from 80 to 250 kilobytes but in either case the capacity is being increased all the time.

Diskette A *floppy* disc, especially the smaller 5¼" size.

DOS Disc Operating System – a computer operating system held on magnetic disc rather than in ROM. An initialisation process will copy the operating system into memory whenever the computer is first turned on. Also an operating system which controls the disc themselves and may supplement, rather than replace, the computer's original operating system.

Dynamic (memory) Random Access Memory (RAM) requiring constant refresh signals but normally using less electrical power than *static* memory.

Duplex A mode of data transmission where each station can send and receive simultaneously.

E

EAROM Electrically Alterable Read Only Memory. Typically taking 10 msec to erase and 1 msec to write, this non-volatile storage might better be considered as 'Read Mostly Memory' as the write capability is likely to be limited to say 100,000 cycles.

EPROM Erasable Programmable Read Only Memory. Writing typically takes one minute and erasing, by ultra violet light, 10 minutes or longer.

Edit Alteration of text in program or data files. Often necessary, some systems make editing easier than others.

Intelligent terminal An input/output device which includes its own logic circuits and memory so that, for instance, data may be validated or changed in format before transmission to the main computer.

Interactive A working arrangement under which the computer reacts immediately to respond to any mistakes which may be made by the user or to reply to his enquiries as soon as they are expressed. In some business activities, as also in program writing, this leads to much faster progress than would otherwise be possible.

Interface The interconnection arrangements between a computer and devices, such as printer or modem, attached thereto.

Interpreter A program to translate a high level language (typically BASIC) to machine language and to execute each instruction, line by line, immediately.

Interrupt A signal which suspends processing to allow some other command to be obeyed.

K

K Abbreviation of Kilo, normally meaning 1000, but 1024 (2^{10}) when referring to *memory*.

Kansas (City) A standard for recording programs and data on cassette tape named after the city where a conference was held at which the standards were agreed.

L

Light pen A stylus with a light sensor which allows a computer to identify the point at which a Video Display Unit (VDU) screen is being touched.

Line printer A computer peripheral which prints a whole line at a stroke, instead of doing each character sequentially.

Load To copy a program (eg from tape or disc) into *memory*, ready for execution.

LSI Large Scale Integration – the combination of more than 100 logical gates (or decision switches) in a small silicon chip.

M

Machine Language (code) The lowest (and tediously detailed)

O

Operating System The computer's resident program which determines how instructions, input and output devices etc are managed.

Overlay A program too long for the available *memory* may be entered and processed by instalments, each segment overlaying or replacing the code previously stored while the various values allotted to common variables would continue from one program to the next.

P

Package A set of programs designed to perform a common task, eg payroll, generalised to suit a variety of users. A turnkey package may comprise both the programs and the equipment on which they run.

Pascal A program language, designed to facilitate structured programming especially on small interactive machines. Named after Gabriel Pascal.

Patch A small piece of computer program inserted in a longer program to remedy some bug or defect in it.

Peripheral Device attached to a central processor, eg printer, plotter, disc unit, but not necessarily essential to its use.

PILOT A programming language for small computers, designed to be particularly appropriate for teaching in schools.

Plotter Computer-driven graphical display using pen on paper.

PROM Programmable Read Only Memory.

R

RAM Random Access Memory. Might be better called 'read and write memory'. Access for reading or writing is normally by direct addressing and is fast, but not random.

Reset (button) A switch whereby computer control is returned to the monitor or low-level operating system and all internal variable values are changed to zero. This may be the only way of getting out of some endless loop which has arisen from a programming error.

Boot An instruction or very short program which will initiate a computer's operating system (short for bootstrap).

bps Bits Per Second — a rate of data transmission between devices Eg 300 bps is a popular rate for some terminals, roughly equivalent to 30 characters per second (cps or chps)

Bubble memory A compact, high-capacity random access *memory* device which holds *data* as minute magnetic domains or 'bubbles'. The data is not lost when power is removed.

Buffer (1) An area of memory designated to hold *data* being transferred between devices working at different speeds, eg the fast processor and the slower keyboard, printer or disc.
(2) An electronic device in a signal path designed to allow signals to pass in one direction but to hold back unwanted reverse voltages which might damage the sending apparatus.

Bug An error in *software*.

Bus (sometimes spelt Buss) Basically means the multiple wiring common to several parts of a computer and the number of channels therein — eg a 16-bit bus addressing 64K memory locations or a 20-way bus addressing 1 megabyte. *Bus* is now generally identified with the pattern of connections to the plugs and sockets whereby optional units (eg more memory) may be connected to a computer.

Byte A unit of data 8 *bits* long.

C

CAD/I/L Computer Aided Design/Instruction/Learning.

Cartridge A protective carrier of magnetic tape (a variant of the familiar cassette) or *disc*.

Central processor The heart of a computer in which the actual program instructions are effected.

Chain A process whereby one computer program automatically follows another.

COBOL Common Business Oriented Language.

Compiler A program whose function is to read another program written in a *high-level language*, such as COBOL or FORTRAN, and convert it to machine code which a computer can obey.

CP/M Control Program/Microprocessor. A popular disc-based operating system for microcomputers using the 8080 and Z80 processors.

cps Characters (rarely cycles) Per Second (sometimes chps).

CPU Central Processing Unit — the heart of a computer, needing the addition of *memory*, *interfaces*, input/output devices and power supply.

CUTS Computer Users' Tape System — a standard for recording data on cassette tape.

D

Daisy wheel The typehead component of a sequential printer — like the *"golf ball"* but faster — whose characters are held on the periphery of a serrated plastic disc.

F

Firmware A program residing in Read Only Memory (ROM).

Floppy (disc) A mass-storage device comprising a soft (floppy) plastic disc with magnetisable surface on which data is recorded and may be accessed rapidly by a moving read/write head. The disc, either 8" or 5¼" in diameter, rotates inside a protective cardboard sleeve.

FORTRAN FORmularTRANslation, an early and still popular high-level programming language, mainly used for scientific purposes.

G

Golfball A type of typewriter (or the print head from which it gets its name) in which the print characters are embossed on the surface of a sphere very similar in size to a golfball. Rotation of the sphere brings the appropriate character into line for each required impression. The process is usually slow (15 cps) but of good quality.

H

Hard copy A computer printout or listing on paper.

Hardware The physical elements of a computer (contrasted with software).

High-level language Programming language usually claimed to resemble a natural language and with powerful instructions, each generating several *machine language* instructions. Examples include BASIC, COBOL and FORTRAN.

I

I–EEE Institute of Electronic and Electrical Engineers (in USA) — a body which has set a number of standards for more orderly interchange of information between various electronic devices, including computers.

I/O Input/Output.

Impact (printer) One which forms characters by striking a ribbon onto paper and can therefore produce carbon copies.

Integer (BASIC) Concerned only with whole numbers, cutting off any fractions or decimal parts.

level of program instructions. All higher level coding must be converted to machine language (by *compiler* or *interpreter*) before a processor can obey it.

Mainframe A relatively large computer distinguished from the peripherals which, with the mainframe, complete the configuration. The term derives from times before integrated circuits, when processors were wired up with large numbers of separate components mounted on circuit cards or boards which were in turn mounted in metal racks or frames enclosed in one or more large metal cabinets.

Matrix (printer) A printer whose characters are formed by selecting a pattern of dots from a matrix typically 5 dots wide and 7 high.

Memory Immediate access data storage, directly addressable by a central processor and typically comprising a combination of RAM and ROM chips.

Micro– (also μ) Prefix signifying one millionth. Also used descriptively of something very small, though not as small as nano– or pico–.

Microprocessor An LSI chip holding a complete processor (arithmetic logic unit and control unit).

Microprogram A very low-level of programming, normally implemented in ROM by the processor's manufacturer, to increase in effect the set of instructions which the processor can obey.

Minicomputer A somewhat vague term for the middle range of computers. Machines addressing up to 64K bytes or words of memory tend (at the present time) to be called Microcomputers and machines able to address more than 64K memory locations tend to be called Minicomputers unless they separate into distinct parts, in which case the processor part may be called a Mainframe.

Mini-floppy The smaller size of floppy disc, 5¼" in diameter.

Modem Acronym for MOdulator/DEModulator — a device adapting computer data for transmission by telephone line and vice versa.

Monitor The first level of computer operating systems: the program which turns machine code commands into action, managing input, output etc.

N

n-sec Nanosecond, one-thousand-millionth of a second.

computing today

Return The key and corresponding computer instruction which sends the contents of keyboard buffer into a computer's memory for execution (term derives from 'carriage return' on a typewriter).

ROM Read Only Memory.

RS232 A communications interface protocol used for modems and for serial printers.

RUN The instruction to execute a program.

S

S–100 Name of a bus or connection standard shared by many manufacturers and employing 100 connection positions. Unfortunately, there are some minor variations between different manufacturers' versions of the S–100 bus but the I–EEE has now defined a universal standard for it. Primarily designed as a *memory* bus and not for general purpose use.

Software The different kinds of program required to work a computer.

Source code A program written in one of the high-level languages and requiring compilation into machine language before use.

Static RAM Random Access Memory which does not require continuous refresh signals but tends to use more power than Dynamic RAM and still loses its contents when power is removed.

String A sequence of alphanumeric characters.

T

Terminal A device, normally remote from the computer, at which data can enter or leave a communication network — eg a tele-typewriter working over telephone lines.

Thermal (Printer) A matrix printer wherein the print impression is made by heating a selected pattern of wires within a matrix (say 5 x 7) so that the heat causes points on the specially-treated paper to darken, to form the selected character.

Time-Sharing A method of operating a computer whereby two or more users apparently enjoy simultaneous access to and control of the machine. In practice what is happening is that the computer is attending to the users one at a time, but in a sequence of time intervals so short that none is normally aware of any delay.

V

VDU Visual Display Unit — a television-type screen on which computer messages can be displayed.

W

Word The specified number of *bits* that a computer is organised to process as a group — eg 16-bit word: but the popular 8-bit word is called a byte.

Word Processor A computer with software for entering, editing, storing, formatting and printing text, rather than processing figures.

between the ground line and the emitter of Q4, you should hear a loud sound when the microphone is tapped or blown against. The remainder of the circuit may then be constructed.

For final testing and setting of the circuit, connect the reset pin to the 5 V supply and use a screwdriver for adjusting the setting of RV1. If RV1 is turned fully anticlockwise, D1 should come on, and stay on, even when an attempt is made to reset the circuit by momentarily disconnecting the reset pin from +5 V. When RV1 is turned fully clockwise, D1 remains permanently off. If either of these conditions is not met, the wiper of RV1 is obviously not able to tap at the correct voltage and the values of R6 and R7 should be altered accordingly. It is allowable to replace R6, RV1 and R7 with a single variable resistor, value 4k7, and one is then certain to find the trigger-point somewhere along its length, but to use a single variable resistor makes the precise setting of the circuit rather more difficult. Assuming that the circuit behaves as described, the next step is to find the setting at which it is just not triggered. Turn RV1 fully clockwise and reset if necessary. Then slowly turn it anticlockwise, whistling or snapping your fingers as you do so. When D1 comes on, try resetting. If the circuit can be reset, the correct position has been found. If not, turn RV1 back a few degrees and try again, turning it only a degree or so at each step. Finding the right position means getting to within a degree of the correct position but, once there, the job is done for good. The circuit should respond instantly to a wide variety of noises at distances up to several metres. It is particularly sensitive to noises with a high-frequency component, such as whistles, squeaks and claps.

Connections To The Microprocessor System

If you use the same socket as was used for joining the LED interface to Acorn, there is no need for modification. Plug it

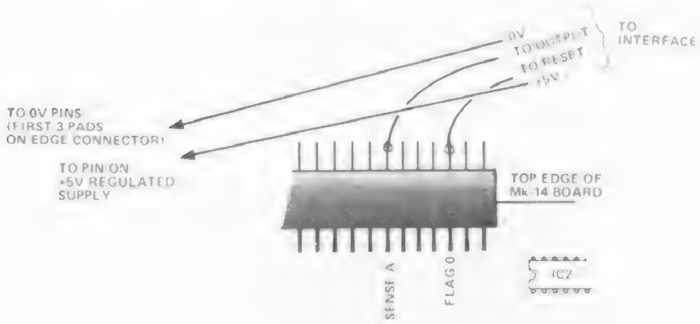


Fig.3. Connections to the Mk-14 main board.

in the correct way round so that the +5 V terminal goes to the top pin and ground to the bottom pin. With this arrangement, the output from the interface goes to Port B0, and the reset function is under the control of Port B2. With Mk-14, you will need to make a new connecting link, or modify the one used for the LED interface. The connections required are Flag 0 to Reset, and SENSE A to Output (Fig.3). It is also possible to operate the device through the I/O device of Mk-14, using a different program.

Operation

The flowchart for the simplest possible program is shown in Fig.4. As a practical example, Program A shows how the 'appropriate action' can be the display of a message when a sound has been detected. Program B carries things still further and allows a sequence of messages to be displayed, – a new message each time a sound is detected. With this program you will find the Mk-14 to be friendly at first, but to

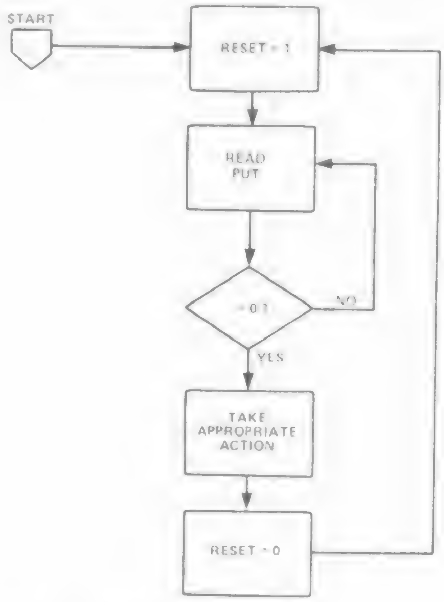


Fig.4. Simple flowchart for the interface.

rapidly tire of your attention. If you persist in making noises at it, it will reply with a continuous sequence of hieroglyphics as it works through the unprogrammed sections of its memory, 8 bytes at a time.

Program C allows you to control a model train by blowing a whistle. By connecting relays to outputs B1, B3 and B4, as described in Part 1 of this series, you can arrange for the train to start, stop or change direction when the whistle is blown once, twice or three times. This and countless other remote-control applications can easily be arranged by various modifications of this program.

After detecting the first sound the input port is scanned a fixed number of times, the number of times being determined by the value assigned in the program to 'k'. If no further sound is detected by the time counter 'k' has been decremented to zero, the program goes on to activate the output port B1. If, during the scanning process, further sounds are detected, a second counter, 'c', is incremented. When 'k' scans are completed, the value of 'c' is used to determine the action to be taken. Note that the values of 'c' corresponding to 1, 2 and 3 (or more) sounds are 0, 1 and 2 respectively.

Those new to programming may find the subroutines of general application in other programs. The delay program sends the MPU to the WAIT routine in monitor several times, depending on the value loaded into Register Y. The whole process is then repeated the number of times set by the value loaded into Register X. With the values given, the program takes action about 5 seconds after the first sound has been detected. In other words, the scanning time is 5 seconds. This can be extended considerably by increasing the value loaded into Register X (and also Y). A longer delay time would allow you to program for an alarm to sound if baby cries more than twice in, say, 5 minutes. Thus the occasional cry would be ignored, but any serious trouble would activate the alarm. The interface has also several applications in intruder-detecting systems. On detecting a sound (or perhaps the second sound in a period of a few

minutes, to obviate spurious triggering) the system could turn on the radio for a while, or take some other action to suggest that someone is at home. If you have neither space nor the cash to keep a hungry Alsation watchdog, program the system to switch on a tape-loop of the sound of a fiercely barking dog whenever a noise is detected.

More Light Sensor Programs

Program D registers and displays how many high inputs are received from the sensor during the period for which the program is run. Use it to count the number of persons entering a room, or the number of objects passing along a conveyor-belt. Program E is the sort of program that can tell when a car-park is full. It displays the total when this reaches a pre-set value. It could, of course, be easily modified to take other action at this stage. Programs F and G are lap-timers, based on the flow-chart of Fig.5. It responds to a low pulse from the sensor which occurs just as the model car (or full-size person) crosses the starting line. It then begins counting hundredths of a second. Counting begins at the instant the light beam is broken and, even if the car is not clear of the beam during the first few hundredths of a second, counting is not interrupted.

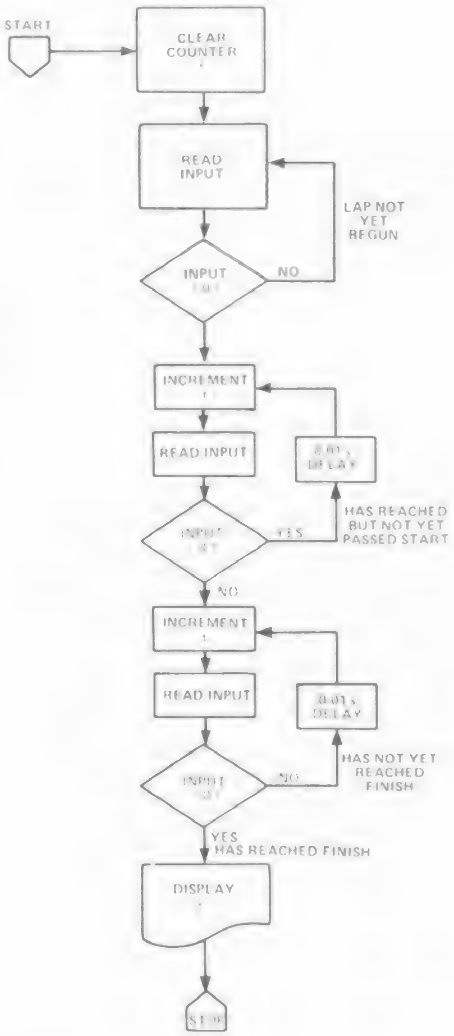


Fig.5. Flowchart for program F.

Counting continues until the instant that the light-beam is broken at the completion of the lap. Both programs are adaptable to allow the start and finish to be monitored by separate sensors, so allowing you to time distances other than a complete lap. The rate of operation may need adjusting if crystals operating at other frequencies are used. Program F contains values suited to a 4.433 MHz crystal. It is a simple matter to run the program for a known period of, say, 30 seconds as measured by an accurate watch and adjust the timing values accordingly. In Program F, these are in 0F32 and 0F48 (and must both be equal); in Program G these are in 0044 and 0054.

Program A: Displays a message when a sound is detected. For 6502 in Acorn (relocatable if message address in program is altered).

```
0030  A9 FE              LDA#FE (1111 1110)
0032  8D 23 09           STA at 0DB, B0 as input, B2 as
                         output.
0035  8D 0A 09           STA clear B2, to reset interface
0038  A0 10              LDY#10
003A  20 CD FE     A :   JSR WAIT          delay to
003D  88                 DEY counting      allow reset
                         down.             to take
003E  10 FA              BPL to A if Y     effect.
                         not zero.
0040  8D 1A 09           STA set B2, reset high to let
                         interface run
0043  2C 08 09     B :   BIT read input
0046  30 FB              BMI to B if input high (no
                         sound)
0048  A2 07              LDX#07
004A  B5 54        C :   LDA Z X54         display
004C  95 10              STA Z 10          message
004E  CA                 DEX
004F  10 F9              BPL to C
0051  4C 04 FF           JMP to RESTART in monitor
0054  7C 79 00 67          message
0058  1C 05 79 78
```

Program B: Displays a new message, in sequence, each time a sound is detected. For SC/MP in Mk-14 (relocatable, if message address in program is altered).

```
0F1E                     = counter, c
0F1F                     = counter, k
0F20  C4 60        A :   LDI '60' message address (low
                         byte).
0F22  32                 XPAL P2 point P2 to message
                         (low byte).
0F23  C4 D0        B :   LDI 'D0'
0F25  C8 F8              ST at c, set counter to X'D0
0F27  C4 0D        C :   LDI '0D'
0F29  35                 XPAH P1           point P1 to
0F2A  C4 00              LDI '00'          display
0F2C  31                 XPAL P1
0F2D  07                 CAS clear Flag 0, to reset
                         interface (00 in AC)
0F2E  C4 0F              LDI '0F'          point P2 to
0F30  36                 XPAH P2           message
                                           (high byte)
0F31  C4 01              LDI '01'
0F33  07                 CAS set flag 0, to let interface
                         run.
0F34  06           D :   CSA read input
0F35  D4 10              ANI '10' to zero all except
                         SENSE A digit.
0F37  9C FB              JNZ to D, in input high (no
```

```
                                sound).
0F39  C4  08            E :   LDI '08'          set counter
0F3B  C8  E3                  ST at k           to X'08
0F3D  C6  01            F :   LD @ P2 + 1 load message
                              character.
0F3F  CD  01                  ST @ P1 + 1 store in display
                              register.
0F41  8F  01                  DLY
0F43  B8  DB                  DLD k, counting down
0F45  9C  F6                  JNZ, to F to fetch next
                              character.
0F47  C6  F8                  LD @ P2 - 8       restore
0F49  C5  F8                  LD @ P1 - 8       pointers
0F4B  B8  D2                  DLD c, counting down
0F4D  9C  EA                  JNZ to E to repeat display
                              routine.
0F4F  90  D1                  JMP to B, to prepare for next
                              sound.
0F60  00  00  3F  38  38  79  76  00    first
0F68  78  79  05  1C  67  00  79  7C    3
0F70  78  06  00  73  3F  78  6D  00    messages
```

Program C: Sets any one of three output ports to energise a relay (etc) depending on whether a whistle (etc) is blown 1, 2 or 3 times. For 6502, in Acorn (not relocatable).

```
0030  A9  FE                  LDA#FE (1111 1110)
0032  8D  23  09              STA at 0DB, B0 as input, B1,
                              B2, B3, B4 as output
0035  A9  00                  LDA#00
0037  8D  21  09              STA at Port B; clear all outputs
003A  A9  80            A :   LDA#80            store number
003C  85  20                  STA Z 20          of scans at
                                                0020 (=k)
003E  20  90  00              JSR to RESET
0041  2C  08  09        B :   BIT read input
0044  30  FB                  BMI to B, if input high (no
                              sound).
0046  20  90  00              JSR sound detected, so go to
                              RESET.
0049  A9  00                  LDA#00            clear counter
004B  85  21                  STA Z 21          at 0021 (=c)
004D  C6  20            C :   DEC Z 20  decrement k
004F  A5  20                  LDA Z 20
0051  F0  10                  BEQ to E, if k = 0 (scanning
                              complete).
0053  2C  08  09              BIT read input
0056  30  05                  BMI to D, if input high (no
                              further sound).
0058  20  90  00              JSR to RESET, because further
                              sound detected.
005B  E6  21                  INC Z 21 increment c, counting
                              sounds.
005D  20  80  00        D :   JSR to DELAY before scanning
                              again.
0060  4C  4D  00              JMP to C, to sample again
0063  A5  21            E :   LDA Z 21 (c, final value)
0065  F0  09                  BEQ to F if c = 0 (one sound
                              only).
0067  49  01                  EOR#01 to test for c = 1
0069  F0  0A                  BEQ to G, if c = 1 (two sounds)
006B  A9  14                  LDA#14 (0001 0100) ports B2
                              and B4 (3 or more sounds).
006D  4C  77  00              JMP to H, to activate outputs
0070  A9  06                  LDA#06 (0000 0110) ports B1
                              and B2.
0072  4C  77  00              JMP to H, to activate outputs
0075  A9  0C                  LDA#0C (0000 1100) ports B2
                              and B3.
0077  8D  21  09              STA at Port B, activate outputs
007A  4C  3A  00              JMP to A to await next
                              command.
```

Subroutine DELAY

```
0080  A2  01            X :   LDX#01
0082  A0  05            Y :   LDY#05
0084  20  CD  FE        Z :   JSR to WAIT (in monitor)
0087  88                      DEY
0088  10  FA                  BPL to Z
008A  CA                      DEX
008B  10  F5                  BPL to Y
008D  60                      RTS
```

Subrouting RESET

```
0090  8D  0A  09              STA clear B2 to reset interface
0093  20  80  00              JSR to DELAY, allowing reset
                              to take effect
0096  8D  1A  09              STA set B2, to let interface run
0099  20  80  00              JSR to DELAY, to allow
                              activation of interface
009C  60                      RTS
```

Program D: Counts high pulses from light sensor. For SC/MP (relocatable) Press and hold Key 0 to read count; release key to begin next count.

```
0F20  C4  01            A :   LDI '01'          P3 pointed
0F22  37                      XPAH P3           to 'Address
0F23  C4  59                  LDI '59'          to segments'
0F25  33                      XPAL P3           subroutine,
0F26  C4  00                  LDI '00'          in monitor
                                                (015A - 1)
0F28  CA  0E                  ST P2+0E (ADH) Clears address
0F2A  CA  0C                  ST P2+0C (ADL) stores, which
                                             are also acting
                                             as counters.
0F2C  A9  00            B :   ILD P1 + 00 To detect if Key 0
                              pressed.
0F2E  9C  02                  JNZ to C, if key pressed
0F30  90  05                  JMP to D, if key not pressed
0F32  3F                C :   XPPC P3 go to display total
                              count.
0F33  90  FD                  JMP to C, illegal return from
                              display routine.
0F35  90  E9                  JMP to A, returning from
                              display, start again.
0F37  06                D :   CSA to detect high input
0F38  D4  10                  ANI '10' all digits except SENSE
                              A become zero.
0F3A  98  F0                  JZ to B if input is low
0F3C  02                      CCL
0F3D  C4  01                  LDI '01'
0F3F  EA  0C                  DAD P2+0C         incrementing
0F41  CA  0C                  ST P2+0C          counter, low
                                                byte.
0F43  C4  00                  LDI '00'
0F45  EA  0E                  DAD P2+0E         adding carry,
0F47  CA  0E                  ST P2+0E          if any, to
                                                high byte
```

```
0F49  06              E :  CSA
0F4A  D4  10               ANI '10' all digits except SENSE
                           A become zero.
0F4C  9C  FB               JNZ to E if input still high
0F4E  90  DC               JMP to B, pulse is finished
0F50                       = 0FF9
0FF9  0D  00               P1 points to keyboard/display
0FFB  0F  00               P2 points to RAM
```

Program E: Counts high pulses from light sensor and displays total when it reaches a pre-set value. Enter preset value in 0022 (thousands and hundreds) and 0023 (tens and units). For 6502, in Acorn (relocatable).

```
0030  A9  FE                   LDA# FE (1111 1110)
0032  8D  23  09               STA at 0DB making port B0 an
                               input.
0035  A9  00                   LDA# 00
0037  85  20                   ST Z 20           clear registers
0039  85  21                   ST Z 20           for count
003B  A2  20                   LDX# 20, to provide for display
                               of 0020 and 0021.
003D  F8                       SED
003E  2C  08  09      A :      BIT read input
0041  10  FB                   BPL to A, if input low
0043  38                       SEC
0044  A9  00                   LDA# 00
0046  65  20                   ADC Z 20, adds 1 to 0020
0048  85  20                   STA Z 20, store new 0020
004A  A9  00                   LDA# 00
004C  65  21                   ADC Z 21, adds carry, if any, to
                               0021.
004E  85  21                   STA Z 21, store new 0021
0050  2C  08  09      B :      BIT read input
0053  30  FB                   BMI to B, if input still high
0055  A5  20                   LDA Z 20   compare tens and
0057  45  23                   EOR Z 20   units of count with
                                          tens and units of
                                          preset value.
0059  D0  E3                   BNE to A if unequal, to await
                               next pulse.
005B  A5  21                   LDA Z 21   compare hundreds
005D  45  22                   EOR Z 22   and thousands
005F  D0  DD                   BNE to A if unequal, to await
                               next pulse.
0061  20  64  FF               JSR to QHEXT 1 to display
                               0020 and 0021.
0064  4C  04  FF               JMP to RESTART in monitor
```

Program F: Lap timer. Controlled by light sensor. Gives time in hundredths of a second. Press ABORT, GO, 0F20 to begin again. For SC/MP (relocatable).

```
0F20 — 0F2B                as in Program D, above
0F2C  06              B :  CSA
0F2D  D4  10               ANI '10' all digits except SENSE
                           A becomes zero.
0F2F  9C  FB               JNZ to B, if input not low (not
                           yet started lap).
0F31  C4  70          C :  LDI '70'          delay 0.01 s
0F33  8F  15               DLY
0F35  02                   CCL
0F36  C4  01               LDI '01'
0F38  EA  0C               DAD P2+0C         Increment
0F3A  CA  0C               ST P2+0C          counter at
0F3C  C4  00               LDI '00'          ADL and
0F3E  EA  0E               DAD P2+0E         ADH
0F40  CA  0E               ST P2+0E
0F42  06                   CSA
0F43  D4  10               ANI '10'
0F45  98  EA               JZ to C, if input still low
                           (passing starting post).
0F47  C4  70          D :  LDI '70'          delay 0.01 s
0F49  8F  15               DLY
0F4B  02                   CCL
0F4C  C4  01               LDI '01'          Increment
0F4E  EA  0C               DAD P2+0C         counter at
0F50  CA  0C               ST P2+0C          ADL and
0F54  EA  0E               DAD P2+0E         ADH
0F56  CA  0E               ST P2+0E
0F58  06                   CSA
0F59  D4  10               ANI '10'
0F5B  9C  EA               JNZ to D, if input still high
                           (finishing post not reached yet).
0F5D  3F                   XPPC P3 go to display routine
                           to show total time.
0F5E                       = 0FFB
0FFB  0F  00
```

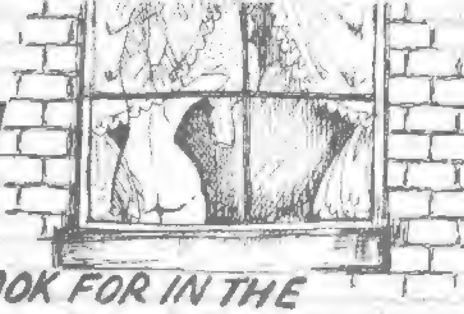
For measured distance timing, use second sensor at finish, input to SENSE B, and alter 0F59 to D4 20.

Program G: Lap timer. Controlled by light sensor. Gives time in hundredths of a second. Press G, to begin again. For 6502 in Acorn (relocatable, if subroutine address at 004B and 005B altered).

```
0030 - 0040,                  as in Program E
0041  30  FB                  BMI to A, if input high (not
                              started yet).
0043  A0  02          B :     LDY# 02
0045  20  CD  FE      C :     JSR WAIT          delay 0.01 s
0048  88                      DEY
0049  10  FA                  BPL to C
004B  20  69  00              JSR to F to register a count
004E  2C  08  09              BIT read input
0051  10  F0                  BPL to B, if input low (still
                              passing start).
0053  A0  02          D :     LDY# 02
0055  20  CD  FE      E :     JSR WAIT          delay 0.01 s
0058  88                      DEY
0059  10  FA                  BPL to E
005B  20  69  00              JSR to F to register a count
005E  2C  08  09              BIT read input
0061  30  F0                  BMI to D if input high (not yet
                              finishing).
0063  20  64  FE              JSR QHEXT D1 display total
                              count (= time).
0066  4C  04  FF              JSR RESTART
0069  38              F :     SEC
006A  A9  00                  LDA# 00           subroutine
006C  65  20                  ADC Z 20          for
006E  85  20                  STA Z 20          incrementing
0070  A9  00                  LDA# 00           counter in
0072  65  21                  ADC Z 21          0020 and
0074  85  21                  STA Z 21          0021.
0076  60                      RTS
```

For measured distance timing, use second sensor at finish, input to B1, and alter 005F to 09.

computing today



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LIVERPOOL FOR THE CUP

Another Brick In the Wall?

Why is this written on a wall?
Did it have to be so tall?
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The Ultimate Systems Review

Never in the field of Personal Computing have so many systems come under the microscope in a single month. We shall be featuring at least six machines in a wide variety of categories from small business, through scientific down to low cost single boarders. Without giving it all away we will be following up on the HP85 in greater detail and also poking around in a newly launched system that is threatening to take the world by storm. After all, if we told you everything you wouldn't want to buy the next issue!

I.G
L
R.H

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H.B. H.B

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Articles mentioned herein are in an advanced state of preparation, however, circumstances may dictate changes to the final contents.

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SAE Enquiries

Dear Sir,

NASCOM 2 Review

I was interested to read your review of operating the NASCOM 2. I have just built one of the first ones to be sold and I thought you might be interested in my comments. I would like to say that overall, in spite of the problems I have had, I am glad I waited for and bought this machine, which is good value for money.

I have found NASCOM willing to replace faulty parts free of charge, fairly rapidly (in one case in one week — not bad for 4,000 miles, there and back, Nairobi — Chesham).

I constructed the main board and the 16K memory with few problems — A dead short on the 16K due to my poor soldering, difficulty in locating parts on the main board, as they were numbered, relative to function, rather than position on the board.

When I inserted the ICs according to instructions I could not get the video to work at all. Detective work with an oscilloscope showed the video PROM u/s. NASCOM replaced this after a short wait, and again -- problems. This time the Memory Decode PROM was at fault.

When this was replaced the Monitor worked, but no BASIC — the fault was eventually traced to a broken track on the Veroboard "mother board" — my fault, due to overtightening a mounting screw. The 16K board was OK.

Correcting this, and my NASCOM worked! (almost) I got only 36 characters across the screen instead of 48. Never mind — I could write BASIC programs that worked!

A week later I sit and look at a screen full of junk — the I/O PROM seems to have died, and today I sent it for replacement. In trying to trace this fault, I think I have found a cure for the 36 character VDU, which may affect other NASCOMs. A 100p capacitor, between IC60/5 and earth, works. I guess it might be IC60/1 on other machines. It can be done neatly to the right of IC4a where the track from IC60/5 goes to IC55/8. I also had to put a 120p on IC65 as per your review.

I am hoping that the DB PROM is not also about to die on me! Perhaps NASCOM have got a bad supply of PROMs, or maybe I was unlucky?

In spite of the above, I would wholeheartedly recommend construction to anyone with a small amount of experience in electronics, providing they can solder and have a 1mm bit on their iron, and providing they can get hold of a 'scope when things go wrong; and can use it to trace a digital signal. I would have been tempted to return the kit a couple of times when I despaired of getting it working had I lived a bit nearer Chesham. But I persevered and learnt a lot about using an oscilloscope, and about digital electronics and how the NASCOM works.

In conclusion can I ask two questions :

1. *How do you CSAVE string arrays other than by using ASC to turn them into numeric arrays first. Maybe they can be POKED into DATA statements and become part of the Program?*
2. *Are there any other NASCOM owners, or computer enthusiasts in Kenya? If so you could contact me at Box 50973 Nairobi; or phone 568431.*

Yours etc.
David R. Green.

P.O.Box 50973,
Wood Avenue,
Nairobi, Kenya.

Dear Sir,

Some comments on the Birthday Competition

For me, a life-long held ambition,
To win some birthday competition,
Could be very close today,
If there be truth in what I say.

I bought a copy of CT
And thought this is the one for me,
But however hard I fought with it
I couldn't get the words to fit.

It seems your man's been on the booze
And cannot add up all the clues,
While eight five-lettered words is fine
Five-lettered clues add up to nine.

Perhaps I'm being too unfair
And with his characteristic flair
He said "I think that we will make
Just one deliberate mistake".

'Send in panic' — not sent was I,
To find the error I did try.
The answer had just letters four,
While your man thought one letter more.

And now I hope I'm not too late —
No mention of your closing date!!
For daylight I at last have seen
The number is three seventeen.

My entry is, of course, under separate cover.
E.L. Foster.

14 The Grove,
Hutton Gate,
Guisborough,
Cleveland.

Dear Sir,

A few months ago, your magazine reviewed the 'TOOLKIT' for the PET. I, like thousands of PET users, have one of these.

One feature of the 'Toolkit' is the automatic line numbering. In the SOFTSPOTS in Computing Today the programs are nearly always excellent, but one irritating problem is the line numbers are never all constant, that is, not one large program has gone up in, say, tens all the way through the program.

This problem is also present when I use larger computers with automatic line numbering facilities. It is awkward, pointless and generally time-wasting to go up in tens, then fives, ones, threes etc.

Please bear this in mind, programmers for CT, and I am sure 'TOOLKIT' users would be very grateful.

Yours faithfully,
Glenn Beard (13).

25 Maesygwernen Drive,
Cwmrhydyceirw,
Swansea,
W.Glam, S.Wales.
SA6 6LN.

Dear Sir,

We really must take you to task for what is almost certainly the most ridiculous piece of software silliness in print.

We refer, of course, to Elaine Douse's Home Finance program for the PET; in the March issue. The program itself was a very creative solution to a mundane problem — however what was not good was the inclusion of a 'password' in it.

Aside from the fact that the very necessity of having a password is questionable, all that on an unauthorised user has to do is press stop, and type 'LIST' to find it out.

The most effective security, is of course to simply lock away your data tapes the way you would with an account book.

If you insist on having passwords, at least disable the interrupt's first (OLDROMs "POKE 537,136", NEWROMs "POKE 144,49") although this isn't really secure. (A small prize if you can figure out why). This disables the 'STOP' key.

Yours superfluously,
Nigel Roberts & Roy Trubshaw.
(Essex University)

P.O. Box 49,
Colchester.

Dear Sir,

You must by now realise that your Birthday Competition Crossword is impossible. There are too many 5 letter words and not enough 4 letter words. I could present you with the 4 letter word I uttered when I discovered this. Unfortunately it does not fit either.

Yours faithfully,
W.N. Bainbridge.

Staddle Stores,
Overthorpe,
Nr. Banbury,
Oxon.

Dear Sir,

I found the 'HOME ACCOUNTS' program by Elaine Douse in your March issue most useful.

Some sections of the program would not operate correctly at first, and I thought you might be interested in the additions/alterations I made.

1. *Line 5190 space between months should be 2 (not 3)*
   Line 6100 should read the same as 6090
2. *To overcome the mathematical 'problem' make the following additions*
   *Line 16 DEF FNA(Z) = INT(Z*100 + .1)/100 and following each calculation (subtraction) add New variable = FNA (New variable) eg Line 2220 becomes*
   T (R) = T (R) – R1: T (R) = FNA (T (R)): GOSUB 2900
3. *Eliminate lines 5380, 5400, 5420, 6295, 6300 and 6310 and alter lines 5320 and 6260 to read*
   5320 IF I = N2 THEN POKE P + B, 102: GOTO 5340
   6260 do. 6280
4. *To overcome the tape recording/reading problems on the 8K I used the following patches*
   Line 5319 POKE 243, 122: POKE 244, 2
   and following each PRINT# statement add GOSUB 900
   " " " INPUT# " " GOSUB 950
   eg line 9372 now reads PRINT#1, N1: GOSUB 900
   " 9670 " " INPUT#1, CH: GOSUB 950
   the necessary subroutines are

```
900 IF PEEK(625) < 180 THEN RETURN
901 POKE 59411, 53: T = TI
902 IF TI – T < 6 THEN 902
903 POKE 59411, 61: RETURN
and
950 IF (ST) > 0 THEN CLOSE 1
951 RETURN
```

Compensation for the additional memory used can be achieved by eliminating spaces in instructions and by using multiple instruction lines.

Yours,
John E. Brennan.

2 Highfield Park,
Rathfadden,
Waterford, Eire.

Dear Sir,

NASCOM 1 ; LOSS OF CURSOR

You have, over the past couple of years published several letters relating to the cure of bugs on NASCOM 1 machines. These items would have been of help particularly for those trying to fault find on a freshly built kit using limited equipment.

During tracing a fault on my own machine I came across a failure which may be of general interest. The problem shows itself by the machine completing the test schedule up to and including clearing the screen after power up. The cursor does not appear at this point. Use of reasonable combinations of new line, space and printing characters does not cause the cursor, nor indeed any other character to appear.

The cause in my case was a two fold problem. The TV set caused the cursor to appear at the bottom left, off the screen, and therefore out of sight. Secondly the ribbon cable connection giving +5V to the keyboard was o/c such that the keyboard was powerless (?) to cause scrolling or printing of characters. The combination of these two faults caused a continuously blank screen despite manual keyboard activity. Use of a colour set precluded the easy adjustment of the display.

Careful soldering of all the joints at both ends of the ribbon cable cured the problem and safeguarded against future problems. Characters immediately after the cursor were sufficiently visible on the TV to unambiguously view the characters.

As a note of caution, delving into the monitor, oscilloscope probing of the power supply, examining for bent IC pins (an illuminating pocket microscope is useful here) and searching for solder bridges and shorts were some of the blind alleys explored prior to the true cause being spotted.

Incidentally I have had good service on missing parts from NASCOM after only a moderate amount of pushing.

C.E. Fernando.

10 Richmond Lane,
Romsey,
Hants SO5 8LA.

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All you need is a TRS-80 Level II 16K. Order No. 0072R

PET

CASINO I These two programs are so good, you can use them to check out and debug your own gambling system!

Roulette — Pick your number and place your bet with the computer version of this casino game. For one player.

Blackjack — Try out this version of the popular card game before you go out and risk your money on your own "surefire" system. For one player.

This package requires a PET with 8K. Order No. 0014P

CASINO II This craps program is so good, it's the next best thing to being in Las Vegas or Atlantic City. It will not only play the game with you, but also will teach you how to play the odds and make the best bets. A one player game, it requires a PET 8K. Order No. 0015P

CHECKERS/BACCARAT Play two old favourites with your PET.

Checkers — Let your PET be your ever-ready opponent in this computer-based checkers program.

Baccarat — You have both Casino- and Blackjack-style games in this realistic program.

Your PET with 8K will offer challenging play anytime you want. Order No. 0022P

MIMIC Test your memory and reflexes with the five different versions of this game. You must match the sequence and location of signals displayed by your PET. This one-player program includes optional sound effects with the PET 8K. Order No. 0039P

TREK-X Command the Enterprise as you scour the quadrant for enemy warships. This package not only has superb graphics, but also includes programming for optional sound effects. A one-player game for the PET 8K. Order No. 0032P

TURF AND TARGET Whether on the field or in the air, you'll have fun with Turf and Target package. Included are:

Quarterback — You're the quarterback as you try to get the pigskin over the goal line. You can pass, punt, hand off, and see the results of your play using the PET's superb graphics.

Soccer II — Play the fast-action game of soccer with four playing options. The computer can play itself, play a single player, two players with computer assistance, and two players without help.

Shoot — You're the hunter as you try to shoot the bird out of the air. The PET will keep score.

Target — Use the numeric keypad to shoot your puck into the hom position as fast as you can.

To run and score all you'll need is a PET with 8K. Order No. 0097P

ARCADE I This package combines an exciting outdoors sport with one of America's most popular indoor sports:

Kite Fight — It's a national sport in India. After you and a friend have spent several hours manoeuvering your kites across the screen of your PET, you'll know why!

Pinball — By far the finest use of the PET's exceptional graphics capabilities we've ever seen, and a heck of a lot of fun to play to boot.

Requires an 8K PET. Order No. 0074P

ARCADE II One challenging memory game and two fast-paced action games make this one package the whole family will enjoy for some time to come. Package includes:

UFO — Catch the elusive UFO before it hits the ground!

Hit — Better than a skeet shoot. The target remains stationary, but you're moving all over the place.

Blockade — A two-player game that combines strategy and fast reflexes.

Requires 8K PET. Order No. 0045P

DUNGEON OF DEATH Battle evil demons, cast magic spells, and accumulate great wealth as you search for the Holy Grail. You'll have to descend into the Dungeon of Death and grope through the suffocating darkness. If you survive, glory and treasure are yours. For the PET 8K. Order No. 0064P

Apple

MATH TUTOR I Parents, teachers, students, now you can turn your Apple computer into a mathematics tutor. Your children or students can begin to enjoy their math lessons with these programs:

Hanging — Perfect your skill with decimal numbers while you try to cheat the hangman.

Spellbinder — Cast spells against a competing magician as you practice working with fractions.

Whole Space — While you exercise your skill at using whole numbers your ship attacks the enemy planet and destroys alien spacecraft.

All programs have varying levels of difficulty. All you need is Applesoft II with your Apple II 24K. Order No. 0073A

MATH TUTOR II Your Apple computer can go beyond game playing and become a mathematics tutor for your children. Using the technique of immediate positive reinforcement, you can make math fun with:

Car Jump — Reinforce the concept of calculating area while having fun making your car jump over the ramps.

Robot Duel — Practice figuring volumes of various containers while your robot fights against the computer's mechanical man.

Sub Attack — Take the mystery out of working with percentages as your submarine sneaks into the harbor and destroys the enemy fleet.

All you need is Applesoft II with your Apple II and 20K. Order No. 0098A

GOLF Without leaving the comfort of your chair, you can enjoy a computerized 18 holes of golf with a complete choice of clubs and shooting angles. You need never cancel this game because of rain. One or two players can enjoy this game on the Apple with Applesoft II and 20K. Order No. 0018A

BOWLING/TRILOGY Enjoy two of America's favorite games transformed into programs for your Apple:

Bowling — Up to four players can bowl while the Apple sets up the pins and keeps score. Requires Applesoft II.

Trilogy — This program can be anything from a simple game of tic-tac-toe to an exercise in deductive logic. For one player.

This fun-filled package requires an Apple with 20K. Order No. 0040A

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Z80A 8 bit. This will run at 4 Mhz but is selected between 1/2/4/Mhz.
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2K Monitor — Nas-sys 1. 1K Video RAM (MK 4118). 1K work space/User RAM (MK 4118). 8K Microsoft Basic (MK 3600 ROM). 8K Static RAM/2708E Pr.

Microprocessors Z80A. 8 bit CPU. This will run at 4MHz but is selectable between 1/2/4 MHz. This CPU has now been generally accepted as the most powerful, 8 bit processor on the market.

INTERFACE

Keyboard New expanded 57 key Licon solid state keyboard especially built for Nascom. Uses standard Nascom, monitor controlled, decoding.

T.V. The Iv peak to peak video signal can drive a monitor directly and is also fed to the on-board modulator to drive the domestic T.V.

I.O. On-board UART (Int. 6402) which provides serial handling for the on-board cassette interface or the RS232/20mA teletype interface.
The cassette interface is Kansas City standard at either 300 or 1200 baud. This is a link option on the NASCOM-2.
The RS232 and 20mA loop connector will interface directly into any standard teletype.
The input and output sides of the UART are independently switchable between any of the options —
i.e. it is possible to house input on the cassette and output on the printer.

PIO There is also a totally uncommitted Parallel I/O (MK 3881) giving 16, programmable, I/O lines. These are addressable as 2 x 8 bit ports with complete handshake controls.

Documentation Full construction article is provided for those who buy a kit and an extensive software manual is provided for the monitor and Basic.

Basic The Nascom 2 contains a full 8K Microsoft Basic in one Rom chip with additional features like DEEK, DOKE, SET RESET for simple programming.

SYSTEM 80 KITS from £225

Microprocessor board* (Nascom 2)
4MHz Z80 CPU; TV or Video + 1200 baud Kansas City + Serial RS 232 printer Interfaces; Keyboard; 128 character ASCII plus 128 Graphics in 2 x 2K ROM; free 16-way parallel port; 8K BASIC; NAS SYS operating monitor. £280 built and tested.

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* Available in kit form.
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NASCOM IMP

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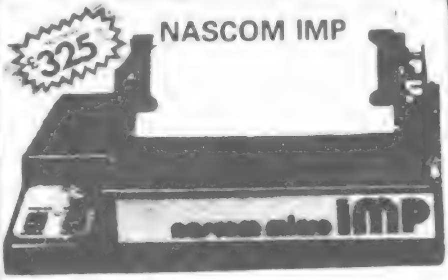

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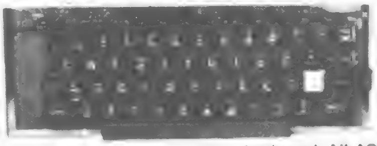

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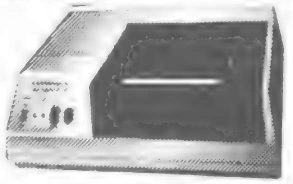

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STOCK MARKET

A complete simulation game for a TI59 but with sufficient detail for implementation on any system.

This is a game which simulates stockmarket activities, such as the buying and selling of shares in different companies, movement of prices, takeovers, bankruptcies, tax, bonuses, suspensions and market collapses. These events are randomly controlled by the calculator.

The object of the game (other than just survival) is to achieve the largest sum of money possible before the inevitable market collapse. A "gift" of £1000 is deposited in the bank at the start of the game, and it is by using this capital to make sound investments that profits will be accumulated. The original and, as yet, unrealised object of the game was to achieve £1 million deposited in the bank. The current record stands at £229,000 at stockmarket collapse.

The game itself has tremendous variety, and the two simple Buy and Sell commands potentially give the player complete control over the situation — if he uses them wisely!

The program and data memories are best recorded on two magnetic cards, making sure before programming that the partition is 639.39. A different game will be played on each occasion provided that either

(i) A different buying and selling scheme is followed
or (ii) Pressing 2nd E' a few times 'warms up' the random number generator.
or (iii) A different random number seed between 0 and 199017 is inserted into register 9.

Games can vary enormously in length due to the random nature of the ending, but an average time of playing works out at about 25 runs, and a good Bank Balance would be about £75,000.

The Background.

The Companies

The scenario is a mythical stockmarket in which investment is possible in four companies involved in mining. The companies themselves adopt the names of the metals they mine. These are :

GOLD, TIN, ZINC, LEAD

Shares are brought in units and the price of these units may vary considerably not only from one metal to another, but in the metal itself. At the start of the game, each company's units are on sale at their average*+ price. See Table.

	"Floor" Value	"Average"	"Ceiling" Value
LEAD	1	10	20
ZINC	5	50	100
TIN	25	250	500
GOLD	125	1250	2500

*This is not precisely true.
+For further discussion of this see 'The Program'

The prices are controlled randomly (See Market News) but with an algorithm which is best described by

(i) If the company is highly priced in its range it has a high probability of dropping in value.
(ii) If a company is mid-priced in its range there is an equal probability of it dropping or rising.
(iii) If a company is low-priced in its range there is an equal probability of it rising in value.

All this means is that if a share is priced below its AVERAGE (which is also its Starting Value) it is best to buy, and if it is priced above, it is best to sell.+

These are obviously general rules and should not be followed verbatim, for the elements of risk taking in letting shares ride high, and suspense in waiting for shares to drop are the spices which add zest to the game.

The Bank

The player has an account into which, at the start of the game, £1,000 has been deposited. This account is credited when shares are sold, and bonuses are gained and debited when purchases are made and tax is due. All these transactions are effected automatically.

There is also a 'Bank' which is in effective control of the game, and which gives interest on money deposited, into which taxes are paid and from which money is paid out.

The interest rate is randomly controlled by the same kind of algorithm as the share prices, and the interest rate varies from

1 — 39%

although this rate is far more stable than the prices.

It is possible to make changes to the program to alter these algorithms and thus change the nature of the game.

See 'Variations'.

Details Of The Game

There are three basic commands in use during the course of the game.

A — This leads directly to the next round which consists of
(i) Market News
(ii) Newsflash (possibly)
(iii) Current Holding
B — Buy
C — Sell

There are also three other minor commands which may be used if necessary

2nd E' — This can be used at the start of the game for 'warming up' the randomiser.
SBRSBR — This can be used at any time when the calculator has stopped for finding out the current Bank Balance.
SBR594 — This can be used to terminate the game, and to reset registers for starting a new game.

Here follows an in-depth study of the various sections.

(i) Market News

The Companies

This is the main vehicle of Stockmarket Events. Each of the companies are printed in turn.

LEAD
ZINC — Followed by the events
TIN — which have overtaken them.
GOLD

These events are listed as follows :

(i) HOLD
The price of the share remains unchanged.
(ii) X UP
The price of shares increases by X
(iii) X DOWN
The price of shares decreases by X
[In the above three cases the new price is printed beneath the message]
Or — there may be a newsflash, followed by
(iv) SUSPENDED
The player may not buy or sell in that company in the current round.

(v) BANKRUPT
All shares held by the player in that company are forfeited, and the company is reset to its starting value.
(vi) TAKEOVER; SELL AT X
All shares held by the player in that company are automatically sold for the price shown.
(vii) TAKEOVER SUSPENDED
Player has escaped takeover at last minute – no shares sold.
[In cases (iv) – (vii) above no share price is printed as no dealings can be made in that company in the current round. If this is tried a message will be printed – "SUSPENDED"]
In cases (v) and (vi) above the shares are reset to their starting value after TAKEOVER and BANKRUPTCY.

The Bank
The Bank news may be
(i) X %
The player will be credited with X% of his current bank account.
There may be a NEWSFLASH here
(ii) SUSPENDED
No interest is printed, and the player receives none in his account.
(iii) FAILS
The Bank collapses and all money therein is lost!
When companies are bankrupt or taken over and the bank fails, they are envisaged as rising, phoenix-like to their former glory in order that as much variety of investment is maintained as possible.

(ii) NEWSFLASH
At moments during the game, the flow *may* be interrupted to go into a NEWSFLASH. There are three NEWSFLASH subroutines – one for companies, one for the bank (both used within the 'Market News' routine) and the third, the main one will be an event chosen at random from over fifty different possibilities.
All movements of money are effected automatically by the Subroutine.
The possible events are :
(i) Market SUSPENDED
The current market prices and Bank Rate is disregarded and a new Market News listing is printed.
(ii) SUPERTAX X% $(10 \leqslant X \leqslant 90)$
The Player's current Bank Balance is debited by X% of the total.
(iii) SUPERTAX SUSPENDED
No effect – A possible supertax cancelled at the last minute.
(iv) TAX BONUS X% $(10 \leqslant X \leqslant 90)$
The Player's Bank Balance is credited with X% of the current total.
(v) TAX BONUS SUSPENDED
No effect – A possible Tax Bonus cancelled at the last minute.
(vi) "Metal" – BONUS X% $(10 \leqslant X \leqslant 90)$
X% of the total value of the player's holdings in the named metal are calculated at Current Market value, and his account credited with this.
(vii) "Metal" – BONUS SUSPENDED
No effect – A possible Metal Bonus cancelled at the last minute.
(viii) "Metal" BONUS ISSUE
The player's current holding in the named metal is examined. He is then awarded one further share in the company for every two owned by him.
(ix) MARKET FAILS – BANK TAKEOVER
This sub-subroutine leads directly to the end of the game. All shares held by the player in each company are sold in turn as in a normal takeover the prices being printed at which each is sold at.
The final bank balance is printed with the message
'GAME ENDED'

N.B. The calculator may not go into this NEWSFLASH Routine at all, and may continue without pause to the next section.

(iii) CURRENT HOLDINGS
Under the title 'YOU HOLD' will be printed a listing of the player's present holdings in each of the companies and the amount in his account, updated to include money and share transactions made as a result of takeovers, taxes bonuses etc.

(iv) BUYING AND SELLING
These are the two *real* options open to the player. A buy or sell command is effected as follows.

ENTER a decimal as follows :	☐ Number of Shares	•	☐ Code of Company	THEN PRESS	B = BUY or C = SELL
e.g.	4	•	3	B	

means *Buy 4 ZINC*

The CODES are as follows :
1 ≡ GOLD
2 ≡ TIN
3 ≡ ZINC
4 ≡ LEAD

N.B. that these codes are in order of value and not in order of printout in 'Market News'.
After entering the instructions and pressing B or C one of several things may happen.
(i) The Calculator prints 'BUY' or 'SELL' followed by the number and metal specified. This means that the instructions have been accepted, understood and acted upon – and the player's bank account has been credited or debited as applicable.
(ii) One of the following messages is printed :
OVERDRAWN :
There are insufficient funds in the player's account to cover the intended purchase.
SUSPENDED
No dealings are allowed in that company in that particular round. (See Market News)
FRAUD
This may be printed for various reasons including :
An attempt to sell non-existent shares
An attempt to buy or sell negative amounts of shares
Entering an undefined code number
(iii) MARKET SUSPENDED
The calculator may suspend dealings in the current market. This will be done *before* buying or selling, and any instructions entered prior to this will be disregarded.
(iv) NEWSFLASH
The calculator goes into the Newsflash Subroutine. This will happen *after* the buying or selling has occurred!
Any number of buyings or sellings may be made if a mistake has been made e.g. 4 gold shares bought by accident, then this may be corrected by selling 4 gold shares.
If after Buying or Selling the Player wishes to inspect his current holdings in the bank he may do so by pressing
SBR SBR

Variations

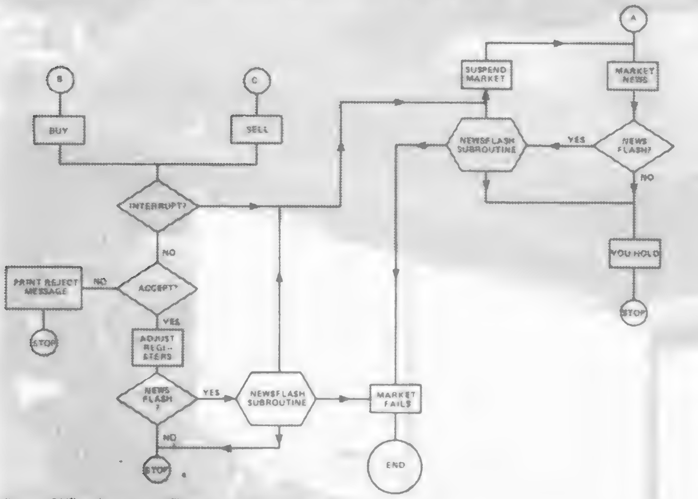
Different games may be played by

1. Inserting different amounts of money in the Bank (register 10) before the start of the game.
2. Inserting a different digit at program step 158. This has the effect of expanding or reducing the scale of price increases and reductions on share values. At present the digit is 4. This gives a '20'-point scale. Other digits give

		approx point scale	
1	–	100	Prices subject to upward drift
2	–	50	More sluggish
3	–	30	
4	–	20	
5	–	18	Prices subject to downward drift
6	–	15	More variable
7	–	13	
8	–	11	
9	–	10	

The effects of this change mean that the 'Average' price of the shares changes, and the effects in the table come into being.

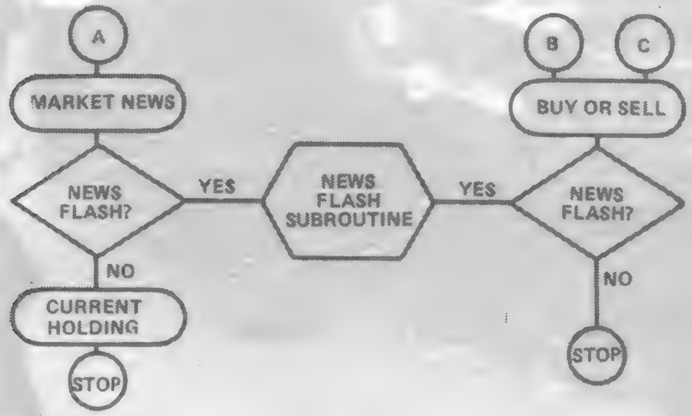
3. Inserting 2nd Nop CLR into program positions 303, 304 mean that on takeover and bankruptcies, shareprices are reset to zero. When they next become available for sale, their prices will not be zero, but will be very low. This could add an interesting twist to the game.



Simplified game flowchart

The Program

The program has a basically simple structure. (See Generalised Flowchart)



Decision routes

The Routines

1. Much use is made of the random number generator from Master Library 1, and a Subroutine and E' is used to convert this into a single digit 0–9. This is tested at various points in the program to provide branching conditions.
2. The variation in market prices is effected by the following method.

(i) The variation in market prices is effected by the following method :

CODE(N)					
1 GOLD	– Register 1	–	contents:–	$X_1 . Y_1$
2 TIN	– Register 2	–	contents:–	$X_2 . Y_2$
3 ZINC	– Register 3	–	contents:–	$X_3 . Y_3$
4 LEAD	– Register 4	–	contents:–	$X_4 . Y_4$

The contents of the registers are two-part information codes.

Xi is the amount of shares held by the player.

Yi (two decimal places) is the amount of units up a 20 point scale, the current market value of the company has risen. The current value of the shares is calculated by

$$Yi \times 5^{(4-n)}$$

e.g. for $Y2 = 15$, the price of tin works out as

$$15 \times 5^{(4-2)} = 375$$

(ii) The price changes by use of the algorithm

$$\text{Price Change} = \left[\begin{array}{c}\text{Random digit} \\ (1-9)\end{array} - 0.4\,Yi\right] \begin{array}{l}\text{INTEGER} \\ \text{PART}\end{array}$$

and all possible price changes are given by

(SHARE VALUE CODE)

(RANDOM NUMBER)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	0	0	0	0	-1	-1	-1	-2	-2	-3	-3	-3	-4	-4	-5	-5	-5	-6	-6	-7	-7
2	+1	+1	0	0	0	0	0	-1	-1	-2	-2	-2	-3	-3	-4	-4	-4	-5	-5	-6	-6
3	+2	+2	+1	+1	+1	0	0	0	0	-1	-1	-1	-2	-2	-3	-3	-3	-4	-4	-5	-5
4	+3	+3	+2	+2	+2	+1	+1	0	0	0	0	0	-1	-1	-2	-2	-2	-3	-3	-4	-4
5	+4	+4	+3	+3	+3	+2	+2	+1	+1	+1	0	0	0	0	-1	-1	-1	-2	-2	-3	-3
6	+5	+5	+4	+4	+4	+3	+3	+2	+2	+2	+1	+1	0	0	0	0	0	-1	-1	-2	-2
7	+6	+6	+5	+5	+5	+4	+4	+3	+3	+3	+2	+2	+1	+1	+1	0	0	0	0	-1	-1
8	+7	+7	+6	+6	+6	+5	+5	+4	+4	+4	+3	+3	+2	+2	+2	+1	+1	0	0	0	0
9	+8	+8	+7	+7	+7	+6	+6	+5	+5	+5	+4	+4	+3	+3	+3	+2	+2	+1	+1	+1	0

REAL MINIMUM VALUE — REAL 'AVERAGE' — REAL MAXIMUM VALUE

Share value table

it can be seen from this table that the 'actual' average price is 12 units up (and not 10 as stated earlier)

i.e. The Mid-Prices are :

LEAD	–	12
ZINC	–	60
TIN	–	300
GOLD	–	1500

A similar algorithm controls the Bank.

The Registers

The contents of the Registers are as follows :

0 USED
1 GOLD
2 TIN
3 ZINC
4 LEAD
(1–4: Coded Information)
5 USED
6 USED
7 USED
8 PRINT CODE
9 RANDOM NUMBER SEED
10 BANK ACCOUNT
11 BANK RATE

Locations 12 to 39 CONTAIN PRINT CODES

User Instructions

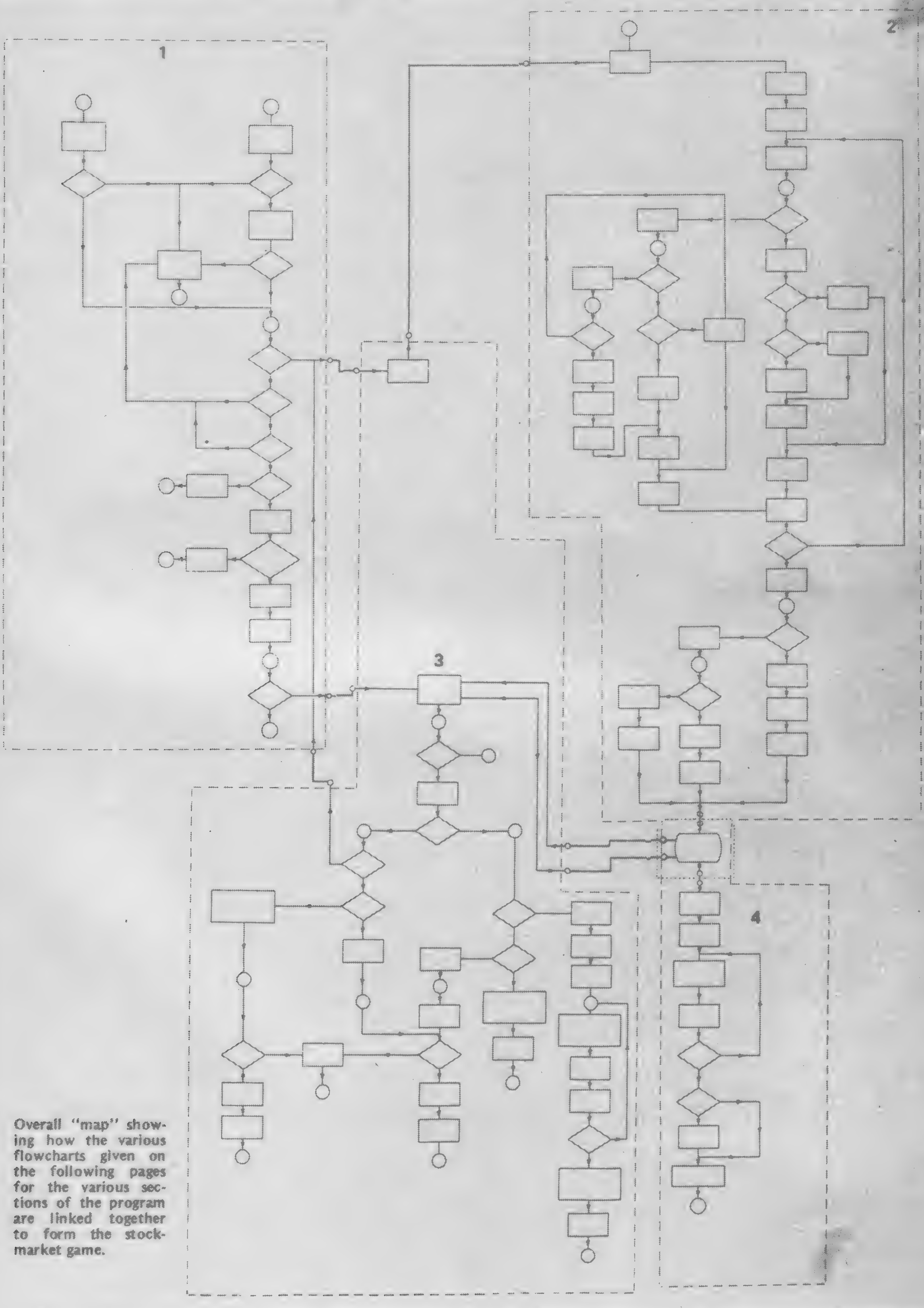
1. Making sure that Master Library 1 is in position and the calculator connected to the printer, reset the partition to 639.39. By command 4 2nd Op 1 7. Enter program and data memories, either from cards (4 sides needed) or from keyboard.
2. To begin the game, press A.
3. Inspect Market News, Newsflash (if any) and Current Bank Balance. Compile coded purchase and enter it pressing B (see 'BUYING and SELLING')
4. When all purchases have been made press A again.
5. Repeat step 3 making sales and purchases as applicable until game is terminated or until £1 million made.

At any point SBRSBR may be pressed to gain knowledge of Bank account.

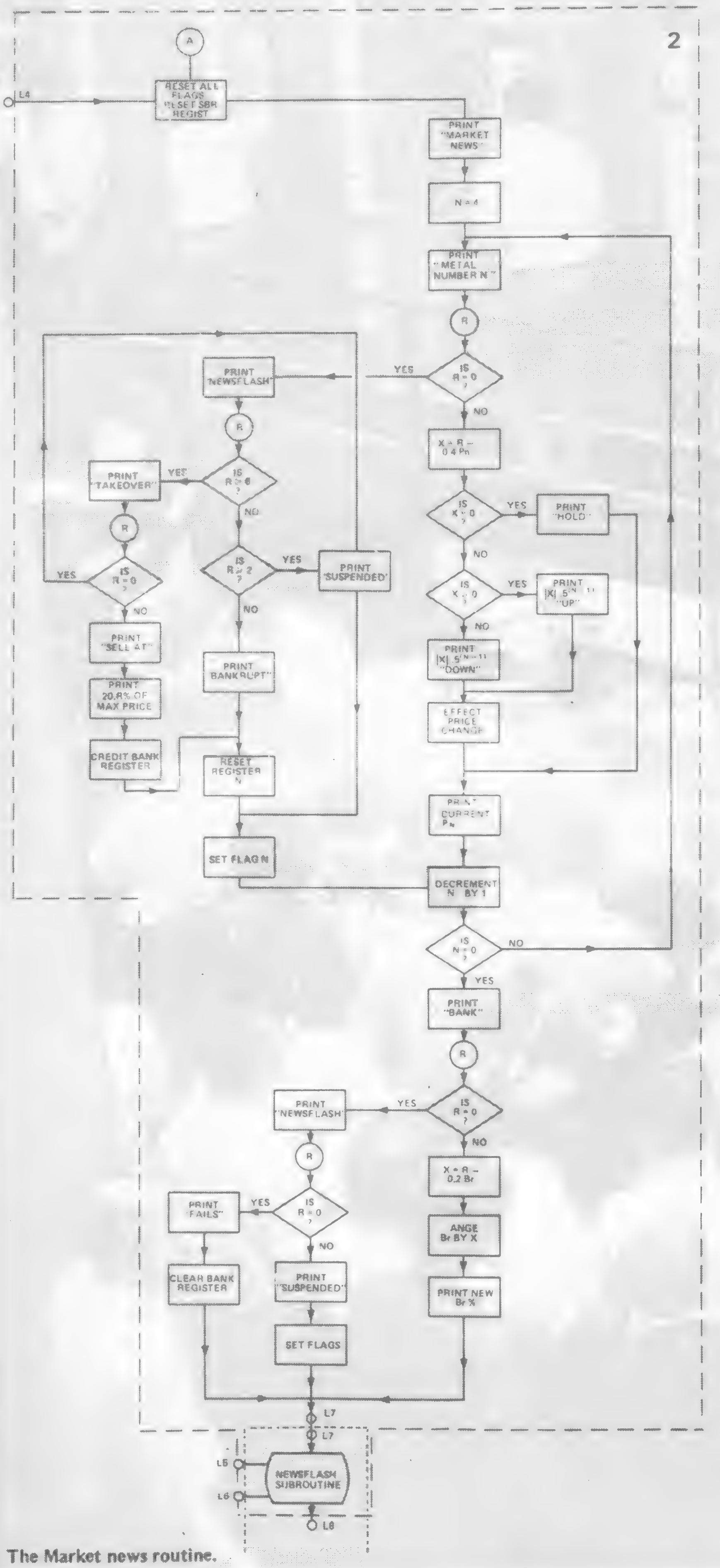
SAMPLE GAME

TO START THE FIRST AND EVERY ROUND, PRESS A.

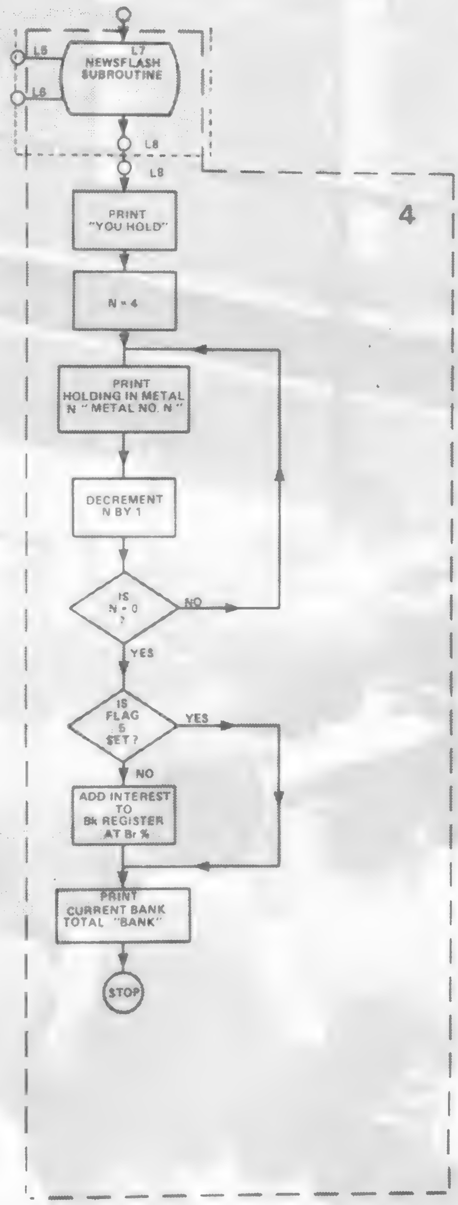
PRINTOUT			COMMENTS
(A)			
MARKET . . NEWS			
LEAD			Lead maintain starting value
HOLD			
	10.		
ZINC			
	25.	UP	Zinc increase from 50 to 75
	75.		
TIN			
HOLD			Tin maintain starting value
	250.		
GOLD			
	375.	DOWN	Gold decrease from 1250 to 875
	875.		
BANK			
	20.	%	Bank rate
YOU HOLD			
	0.	LEAD	
	0.	ZINC	
	0.	TIN	
	0.	GOLD	
	1200.00	BANK	Bank = £1000 at 20% = £200 extra
4.2			
(B)			
BUY	4.	TIN	4 TIN units bought at £250 each
SBR SBR			
	200.00	BANK	£200 left
(A)			
MARKET . . NEWS			
LEAD	2.	UP	
	12.		
ZINC			No dealings in Zinc allowed
NEWSFLASH			
SUSPENDED			
TIN			
	50.	UP	Our investment in Tin is paying off
	300.		
GOLD			
	500.	UP	
	1375.		
BANK			
	22.	%	
NEWSFLASH			
TIN			Fortunate! This gives an extra £1080. i.e. 4 Tin shares at £300 = £1200 90% of £1200 = £1080
BONUS			
	90.	%	
YOU HOLD			
	0.	LEAD	
	0.	ZINC	
	4.	TIN	
	0.	GOLD	
	1561.60		
4.2			
(C)			
SELL			
	4.	TIN	
(A)			
MARKET . . NEWS			
LEAD			
	4.	UP	
	16.		
ZINC			Zinc almost reach ceiling
	15.	UP	
	90.		
TIN			
	50.	DOWN	
	250.		
GOLD			
	250.	DOWN	
	1125.		
BANK			
	19.	%	
NEWSFLASH			Calculator suspends market goes into new 'Market News'
MARKET . .			
SUSPENDED			
MARKET . . NEWS			
LEAD			
HOLD			
	16.		
ZINC			Zinc drop from their 'ceiling'
	20.	DOWN	
	70.		
TIN			
	25.	DOWN	
	225.		
GOLD			
	125.	DOWN	
	1000.		
BANK			
	19.	%	
NEWSFLASH			
TAX BONUS			Bonus of 50% of Account
	50.	%	
YOU HOLD			
	0.	LEAD	
	0.	ZINC	
	0.	TIN	
	0.	GOLD	
	4929.46	BANK	Current Bank level



Overall "map" showing how the various flowcharts given on the following pages for the various sections of the program are linked together to form the stock-market game.



The Market news routine.

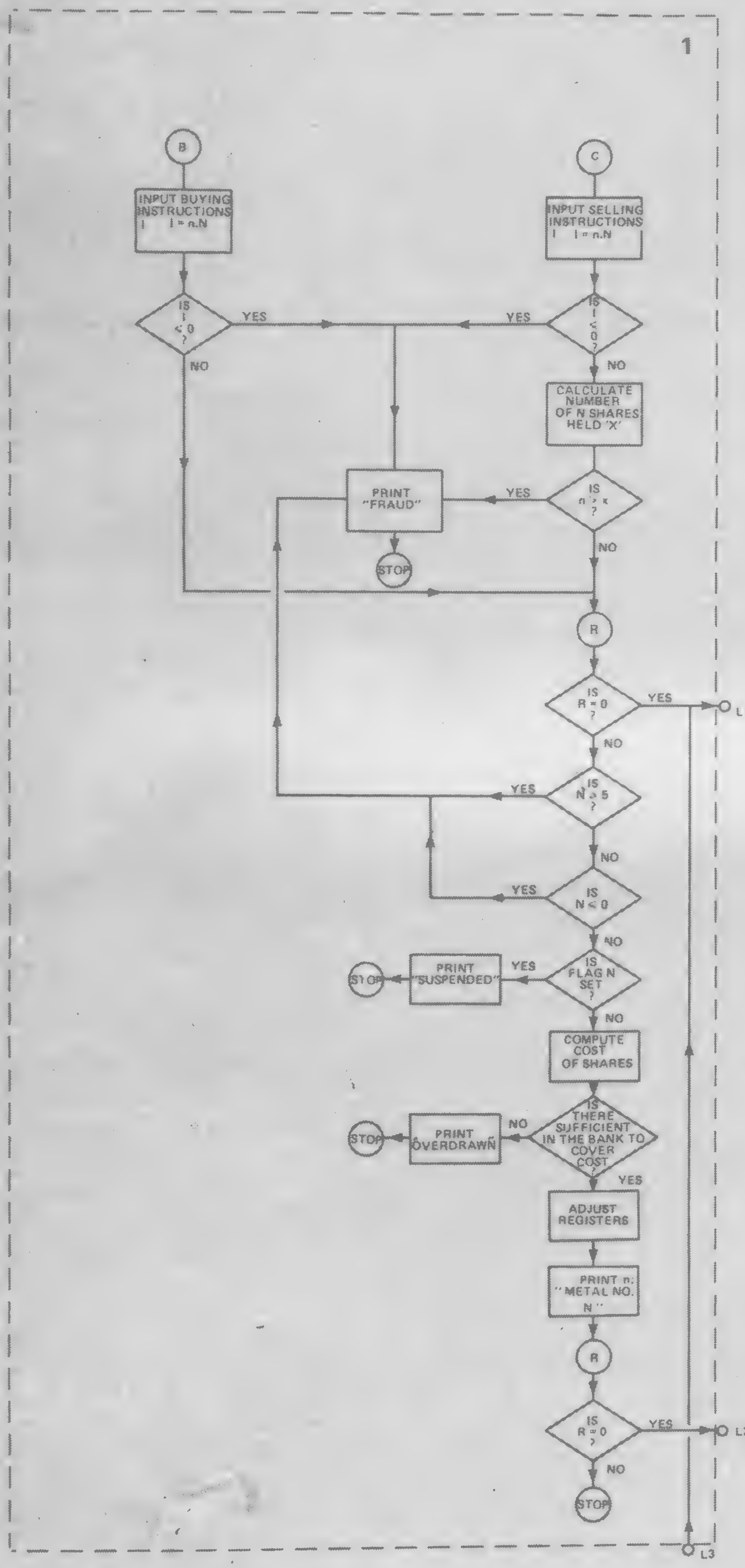


The current holding routine

Note that the two routines detailed here share a segment – this has been drawn twice for clarity.

```
2.1
B
BUY
           2.    GOLD
NEWSFLASH              Newsflash after Buying
LEAD
BONUS
          60.    %     No lead shares owned
----------------------------------------------
4.2
B
BUY        4.    TIN
----------------------------------------------
A
MARKET . . NEWS
LEAD
NEWSFLASH
SUSPENDED
ZINC
          15.    DOWN
          55.
TIN
          75.    UP    Tin investment increases in
         300.          value
GOLD
HOLD
        1000.          Gold maintains
BANK
          19.    %
NEWSFLASH
GOLD                   We hold 2 gold shares. We
BONUS ISSUE            obtain a further 1.
YOU HOLD
           0.    LEAD
           0.    ZINC
           4.    TIN
           3.    GOLD  3 gold now held
     2415.05     BANK
----------------------------------------------
4.2
C
SELL
           4.    TIN   Sold all tin shares
----------------------------------------------
SBR SBR
     3615.05     BANK
----------------------------------------------
2.1
B
BUY
           2.    GOLD  Buying into Gold
----------------------------------------------
A
MARKET . . NEWS
LEAD                   No dealings in lead allowed
NEWSFLASH
SUSPENDED
ZINC
          15.    DOWN  Zinc now worth buying
          40.
TIN
NEWSFLASH
TAKEOVER               Takeover — at very low price
SELL AT
          50.
GOLD
```

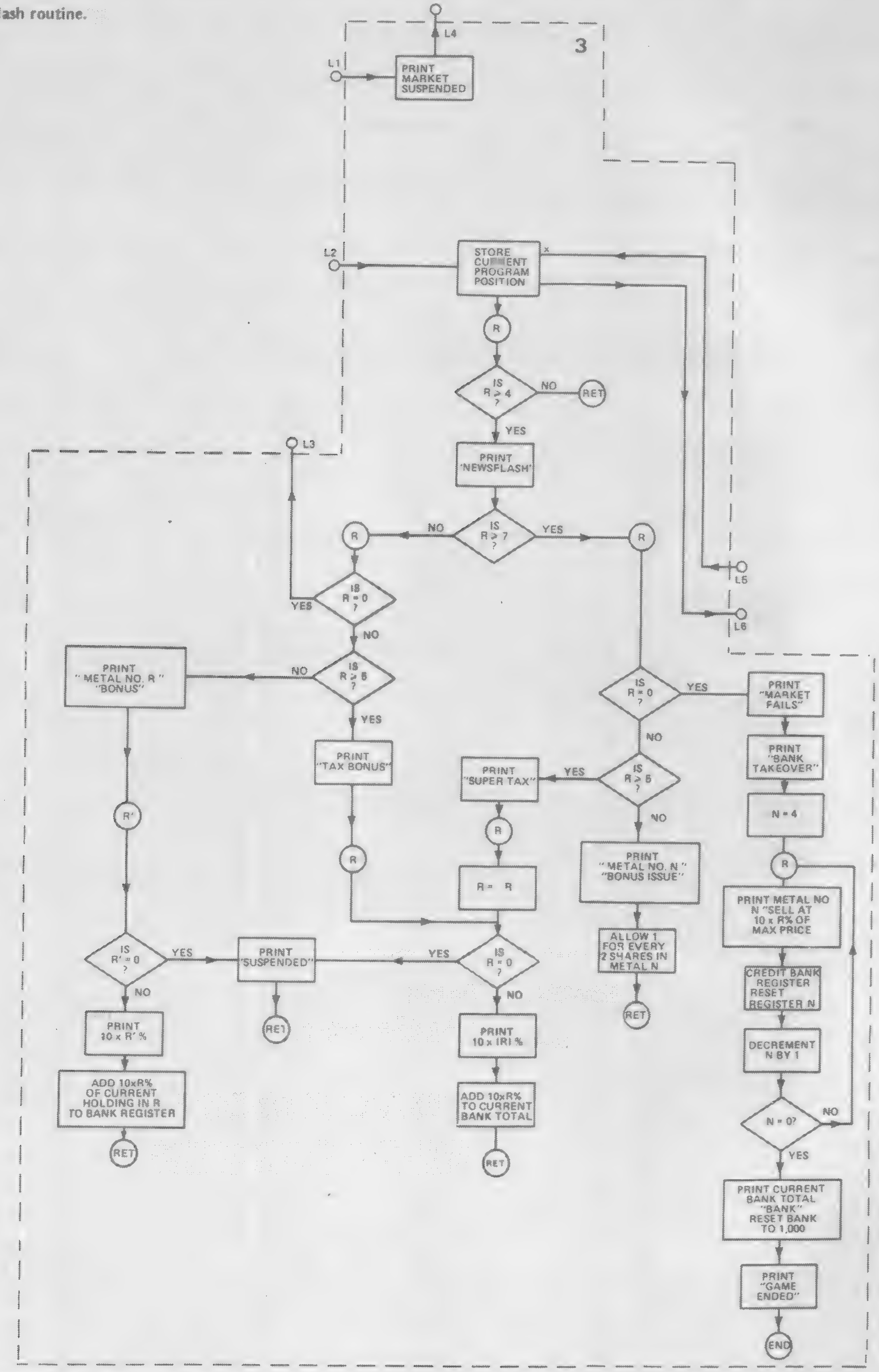
```
HOLD
        1000.
BANK
          23.    %
NEWSFLASH
ZINC
BONUS ISSUE
YOU HOLD
           0.    LEAD
           0.    ZINC
           0.    TIN
           5.    GOLD
     1986.51     BANK
----------------------------------------------
15.3
B
BUY       15.    ZINC
----------------------------------------------
A
MARKET . . NEWS
LEAD
           4.    DOWN
          12.
ZINC
          25.    UP    Good profit made on Zinc
          65.
TIN
         100.    UP
         350.
GOLD
HOLD                   Still no movement in Gold
        1000.
BANK
          26.    %
YOU HOLD
           0.    LEAD
          15.    ZINC
           0.    TIN
           5.    GOLD
     1747.01     BANK
----------------------------------------------
15.3
C
SELL      15.    ZINC
----------------------------------------------
SBR SBR
     2722.01     BANK
----------------------------------------------
1.1
B
BUY
           1.    GOLD
----------------------------------------------
A
MARKET . . NEWS
LEAD
           3.    UP
          15.
ZINC
NEWSFLASH
SUSPENDED
TIN
```



The Buy and Sell routines.

By now you will undoubtedly have noticed there is no listing given here for this program. If you own a TI–59 and would like a copy, an SAE to our Charing Cross Offices will bring you one Post Office Haste. For owners of other machines the flow charts herein should assist in getting the program converted. We'd be very interested to see a BASIC version of this simulation, so if you get it running – give us a shout!

The Newsflash routine.



```
HOLD
        350.
GOLD
HOLD                          Still no movement in Gold
       1000.
BANK
         26.   %

YOU HOLD
          0.   LEAD
          0.   ZINC
          0.   TIN
          6.   GOLD
    2169.73   BANK   Nothing to do
```

```
(A)
MARKET . . NEWS
LEAD
          2.   DOWN
         13.
ZINC
NEWSFLASH
TAKEOVER
SELL AT
         70.
TIN
HOLD
        350.
GOLD                          After all that it goes down!
        125.   DOWN
        875.
BANK
         28.   %
NEWSFLASH
TAX BONUS                     Massive Tax Bonus!!
         90.   %

YOU HOLD
          0.   LEAD
          0.   ZINC
          0.   TIN
          6.   GOLD
    5276.79   BANK
```

```
4.1
(B)
BUY
          4.   GOLD   Buy while they're cheap
```

```
(A)
MARKET . . NEWS
LEAD
          1.   DOWN
         12.
ZINC
         10.   UP
         60.
TIN
         50.   DOWN
        300.
GOLD
        750    UP     Massive increase.
       1625.          Worth waiting for.
BANK
         24.   %
NEWSFLASH
SUPER TAX
         40.   %

YOU HOLD
          0.   LEAD
          0.   ZINC
          0.   TIN
         10.   GOLD
    1321.93   BANK
```

```
10.1
(C)
SELL
         10.   GOLD
```

```
SBR SBR

   17571.93   BANK
```

```
(A)
MARKET . . NEWS
LEAD
          1.   UP
         13.
ZINC
NEWSFLASH
SUSPENDED
TIN
         25.   UP
        325.
GOLD
        125.   UP     Should have waited!
       1750.
BANK
         25.   %
                      Ending!
NEWSFLASH             Calculator selling off shares
MARKET . . FAILS
BANK
TAKEOVER
LEAD
SELL AT
         18.
ZINC
SELL AT
         10.
TIN
SELL AT
        250.
GOLD
SELL AT
       2250.

YOU HOLD
   17571.93   BANK

GAME ENDED            END OF GAME
```

Total amount £17,571 . . . but game very short.

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Stephen Hemingway

Let the computer do the work with this low cost cassette interface for the Mk 14.

The tape interface described here uses a tone of 2 kHz for logic 1 and no-tone for logic 0. This type of circuit has the disadvantage that an initial bit of zero will go undetected, since the lead-in tape is equivalent to logic 0. As such the software needs to be designed to cope with this — as is done on the Mk-14.

Since it may be desired to use this interface with other microprocessors an outline of the kind of software required will be considered.

As any initial zeros will be missed a start bit of logic 1 is necessary — to inform the microprocessor that what follows is data. As with any cassette tape system, reliance upon constant speed is not possible and therefore it is necessary to have short breaks in the data on the cassette — where the program can get back into step with the tape.

Getting Round It

There are two methods of satisfying the above requirements. The first is where each byte is recorded with an initial bit of one and after the eight bits of data there are two bits of zero. Thus each byte is composed of eleven bits when recorded on the tape. The other method, which is used on the Mk-14, is to encode each bit. If the bit of data is considered as two units long, then there is a one unit start sub-bit of logic 1 and then a two unit data bit followed finally by three units of logic 0 — comprising the stop sub-bit. These two forms are represented diagramatically in Figure 1, along with the format used with most FSK interfaces. As the FSK type software generates a start bit of zero, and stop bits of one it will be necessary to invert the output from and the input to the microprocessor.

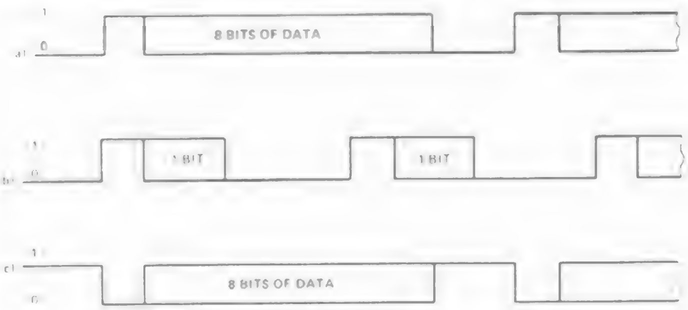


Fig.1. The three methods of recording data :
a) Similar method to FSK but interface compatible,
b) The Mk-14 method,
c) The FSK method.
Note that if you use software for c) the input and output of the interface need to be inverted.

Simplified flow-diagrams are given for the first two methods and it should be quite easy to convert these to machine code for different microprocessors. The circuit extends a logic 1 slightly, on decoding, as such it may be necessary to modify the software slightly (or try adding a 10 ohm resistor in series with C6), but with the cheapness of the circuit to build — with relation to other interfaces it is worth trying.

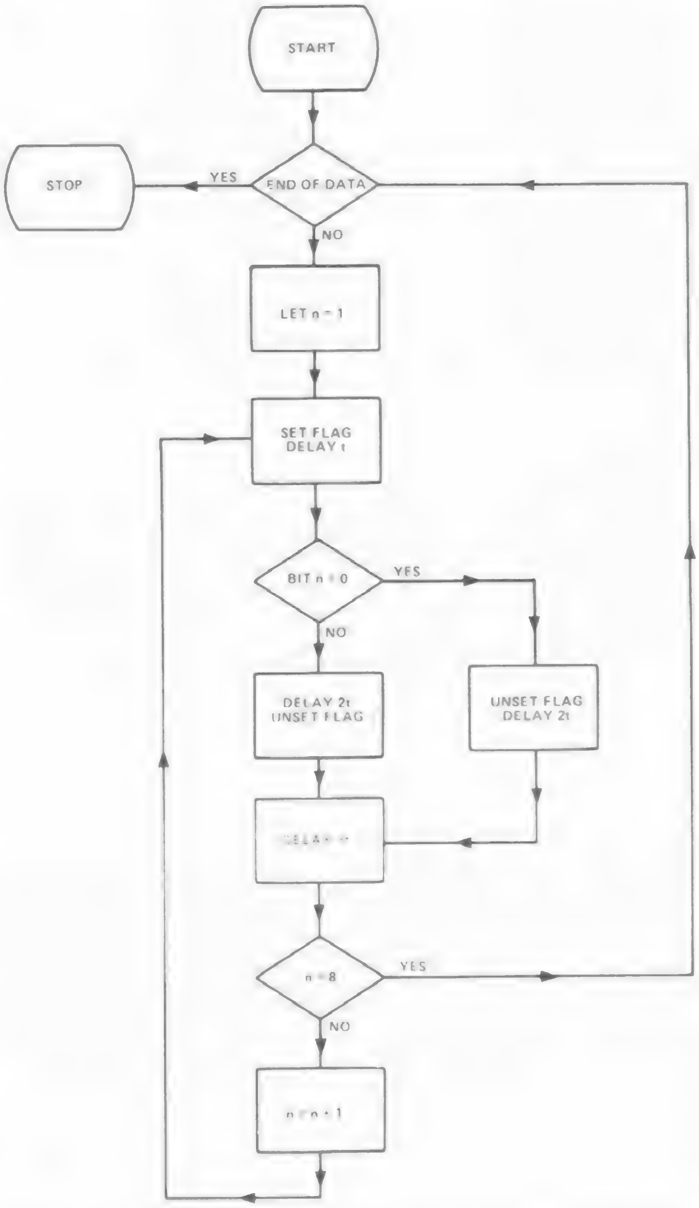


Fig.2. Flowchart 2a) shows output of data by method 1b) and 2b) shows data input by the same method.

Since everything to do with this circuit was on a very low budget, the cassette recorder used had an automatic level control — ALC (which many tape interfaces are advised to stay away from).

A Problem Start

The tape interface suffered from a few problems when first used and these were due to the recorder picking up any electro-magnetic radiation, up to and including radio frequencies. These were removed by screening the tape recorder and the correct adjustment of RV1.

Since the power was taken from the Mk-14 (not advised), noise over the whole spectrum was being fed into the recorder and if you find that you have this problem, to a high level, IC2a should be included.

The circuit, after these precautions worked at home, but when taken to school (where the Mk-14 belongs) it refused to work when a nearby Teletype was operated. This was because the Teletype acted as a weak spark transmitter, which caused 'clicks' on the tape. The problem has two solu-

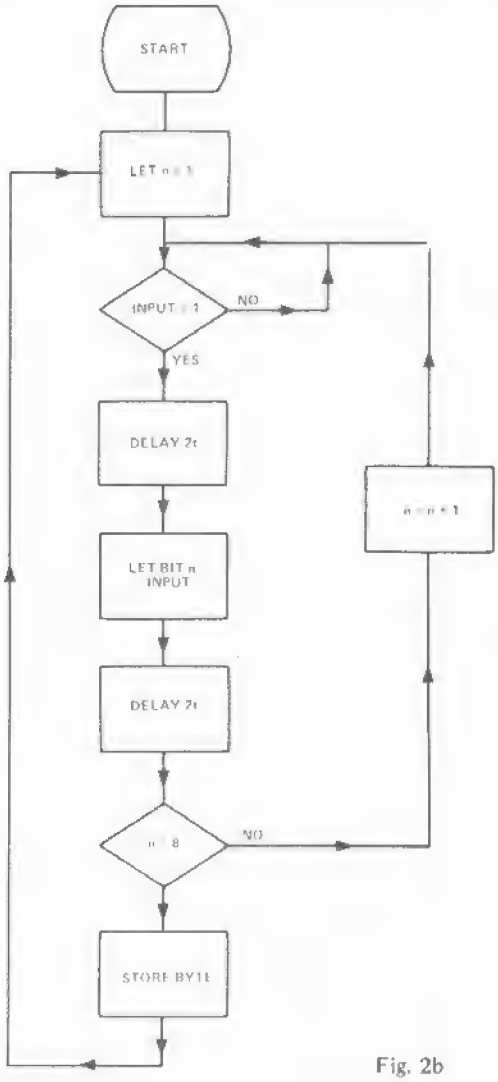


Fig. 2b

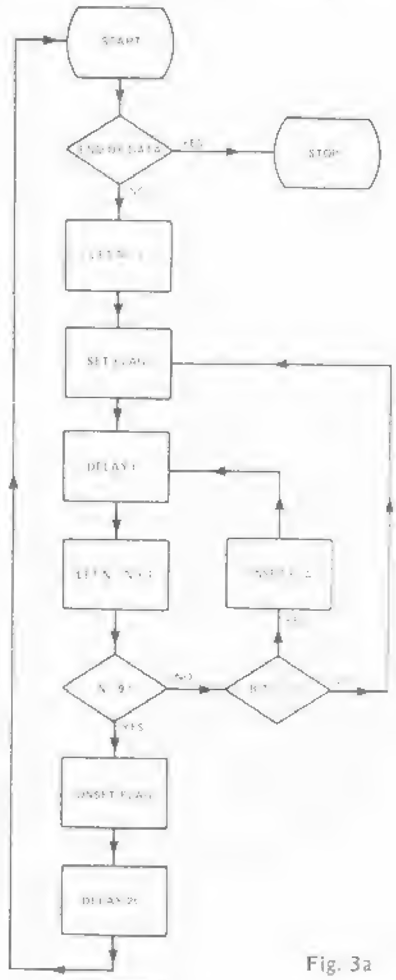


Fig. 3a

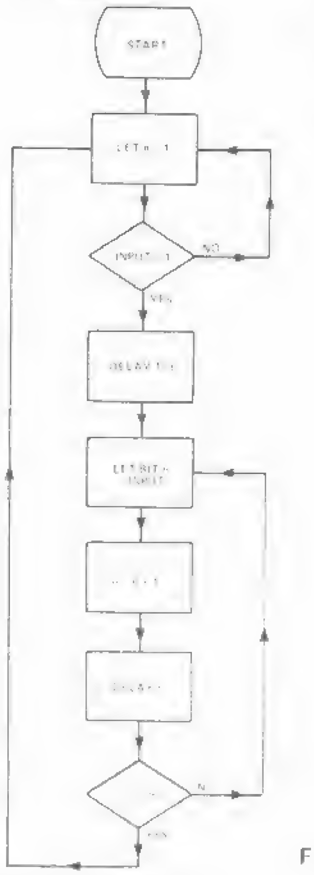


Fig. 3b

Fig.3. As Fig.2 but using method 1a).

tions -- buy a better tape recorder, or stop typing on the Teletype when programs are being recorded. So systems using Teletypes, BEWARE!

Construction

The circuit was constructed on a piece of veroboard (Figure 6), the board should be larger than shown, in case it is necessary to include IC2. The breaks in the board are made first, followed by the wire links. The components may then be mounted in any order.

Should it be found later that IC2 is required – with your tape recorder, then break the track at B19 and connect B18 to the input of the inverter and B20 to the output of the inverter. The inverter can be obtained from a 7400.

For best results screened leads need to be used to connect up to the tape recorder. The supply was taken from the Mk-14. However, this is not advised, since the regulator may be pushed past its limits.

Set-Up And Adjustment

When the circuit is first switched on the LED should flash momentarily – if not the LED is probably the wrong way round. Plug the circuit into the microphone input and start recording.

The flag 0 input should now be alternately touched to ground and allowed to float, at about half second inter-

vals, for about ten minutes. A program to do this is in Table 2. On non-ALC recorders vary the record level control by set increments every 2 minutes, make a note of the counter value at the points where the record level changes, or leave a 10 second blank.

Once this has been done the earphone output is connected to the interface and the tape played back. The following procedure is required to determine the volume level necessary :

1. Set the volume level to half of the maximum.
2. Adjust RV1 until the LED pulses clearly, without flickering. If the flickering of the LED cannot be removed the volume level needs increasing.
3. The volume needs now to be adjusted, until half-way between the point where the LED begins to flicker and the point where the LED lights in the pauses. (with non-ALC recorders, the procedure should be repeated with each record-level.) The correct level to use is when the margin between the flicker-point and the point where lighting occurs in the pauses is greatest.

The connections between the interface and Mk-14 can now be made. (sense B = 28, serial input = 27 and flag 0 = 30 on the edge connector)

For a quick check to see if the interface works, record the data in Table 3 and write it back at address 0D00. This will cause the numbers 0 to 7 to flash across the display.

Recording procedure :– The length of the program, in bytes, is written at 0FF8, and the start address of the program is written into pointer 1 (0FF9, 0FFA in the stack register). The tape output program, at 0052 is now run.

Play-back procedure :– Pointer 1 is now set to the address where the program is to be written. The tape input program at 007C is run. When the LED stops flashing the program has been read in. When changing the pointers do not use the red reset switch, as this sets them to zero.

For those who wish to try using this interface with other microprocessor systems, at higher data rates, the following may be of use to remedy errors which occur.

1. If all the data is written as 1's, then the value of C6 should be reduced (place a 10 to 15 ohm resistor in series with it).
2. If the data appears to be random – re-adjust the volume and RV1 or increase the value of C6.
3. If most of the data is correct except for a few bits, or shifting of bits has occurred, then there is too much noise and IC2a should be included in the circuit.

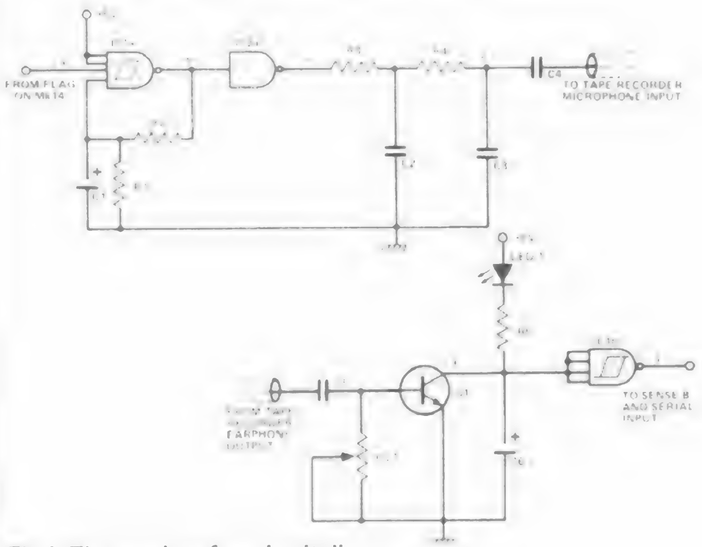


Fig.4. The tape interface circuit diagram.

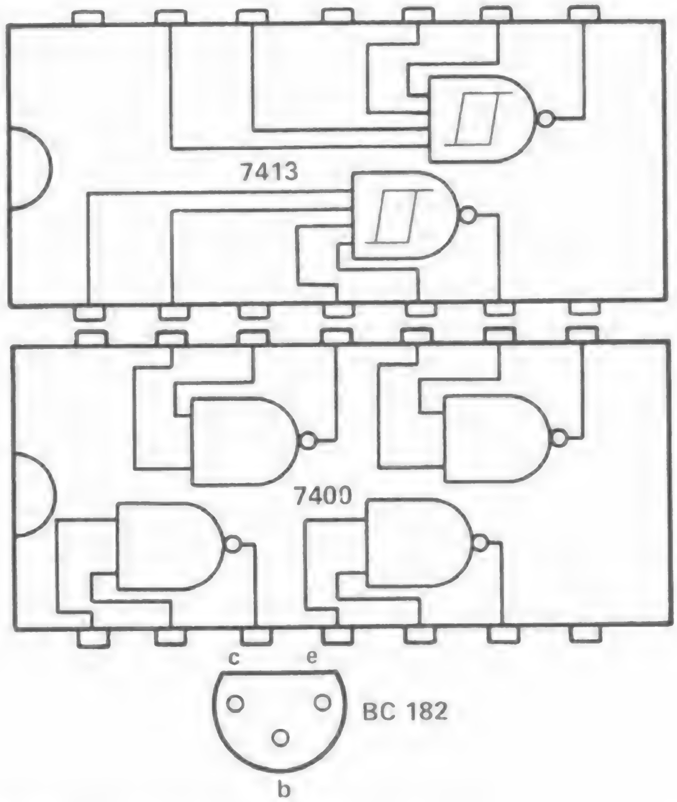


Table 1: Pin connections to semiconductors

PARTS LIST

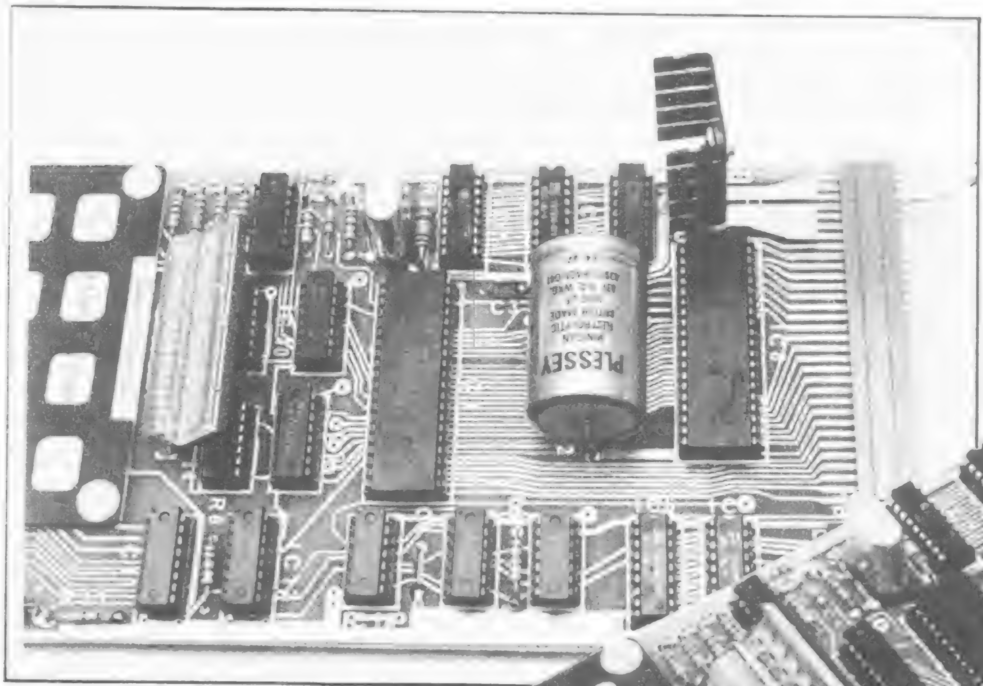
RESISTORS	All ¼W
R1	1k2
R2	390R
R3,4	1k0
R5	330R
RV1	5k0 preset
CAPACITORS	
C1	1u0
C2,3	10n
C4,5	100n
C6	4u7 electrolytic
SEMICONDUCTORS	
IC1	7413, Dual NAND Schmitt trigger
IC2	7400, One gate used as an inverter
D1	Red LED
Q1	BC182, most NPN switching transistors should work

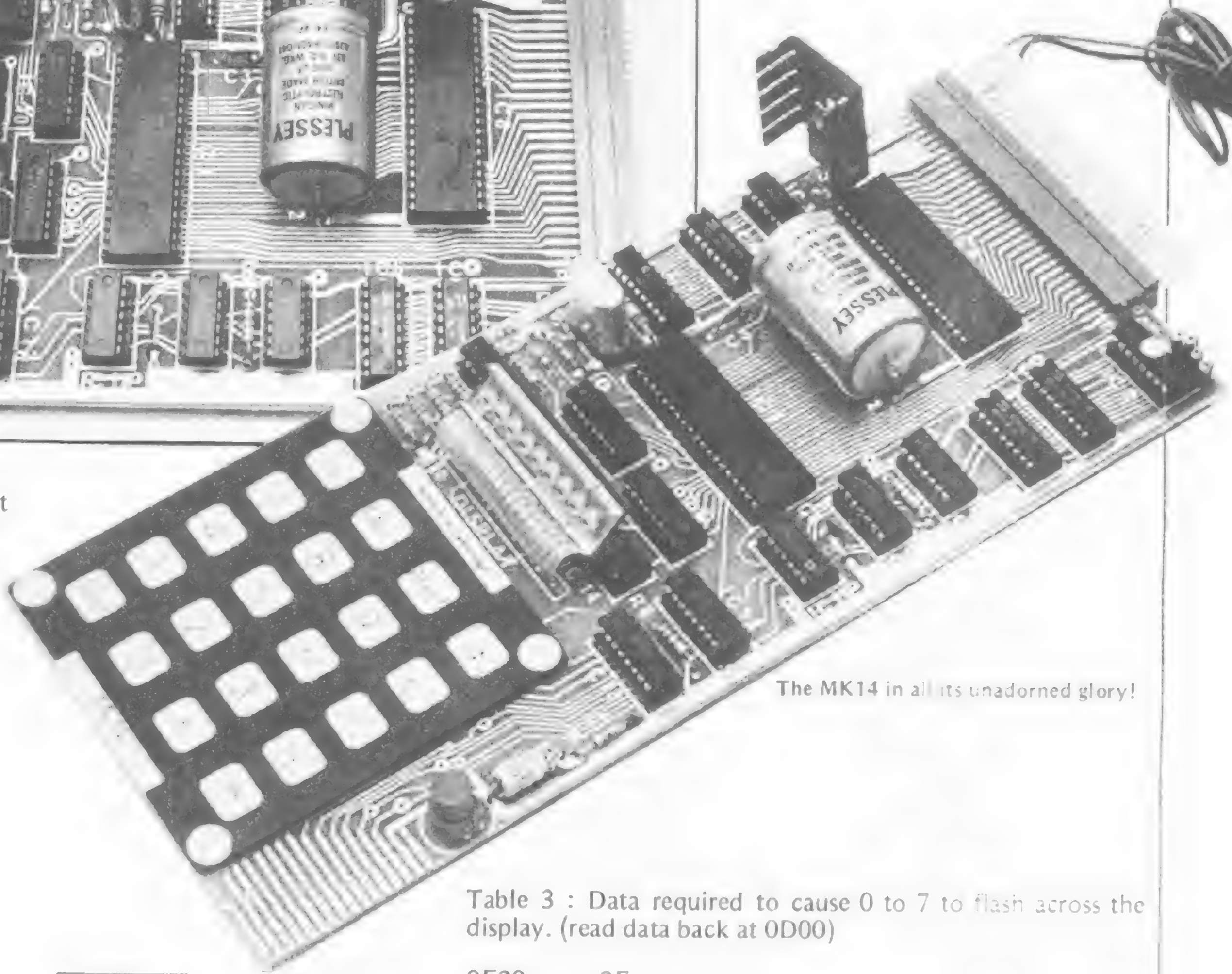
HOW IT WORKS

The input from the Mk-14 (Figure 5a) enables the Schmitt trigger oscillator circuit (IC1a) – producing a 50% duty-cycle squarewave. This is then either left uninverted (Figure 5b) or inverted by IC2a (Figure 5c). If the signal was inverted then the amplitude of the signal is much reduced – meaning a reduction in the noise level in the no-tones (Figure 5e), else if the signal was not inverted Figure 5d is produced.

In the encoder circuitry, when there is a tone, the signal switches Q1 and discharges C6, bringing the output of IC1b high. While the tone continues C6 is repeatedly discharged (Figure 5f). However, when the tone stops C6 charges through D1, bringing the input high and the output low (Figure 5g). Thus IC1b acts as a retriggerable monostable.

MK14 CASSETTE INTERFACE





The MK14 in all its unadorned glory!

Table 2: Program to set and reset flags at half-second intervals.

0F20	07	
0F21	8F	FF
0F23	8F	FF
0F25	8F	FF
0F27	07	
0F28	8F	FF
0F2A	8F	FF
0F2C	8F	FF
0F2E	C4	20
0F2F	34	

Table 3 : Data required to cause 0 to 7 to flash across the display. (read data back at 0D00)

0F20	3F
0F21	06
0F22	5B
0F23	4F
0F24	66
0F25	6D
0F26	7D
0F27	16

0FF8 = 07 (count)
0FF9 = 0F
0FFA = 20

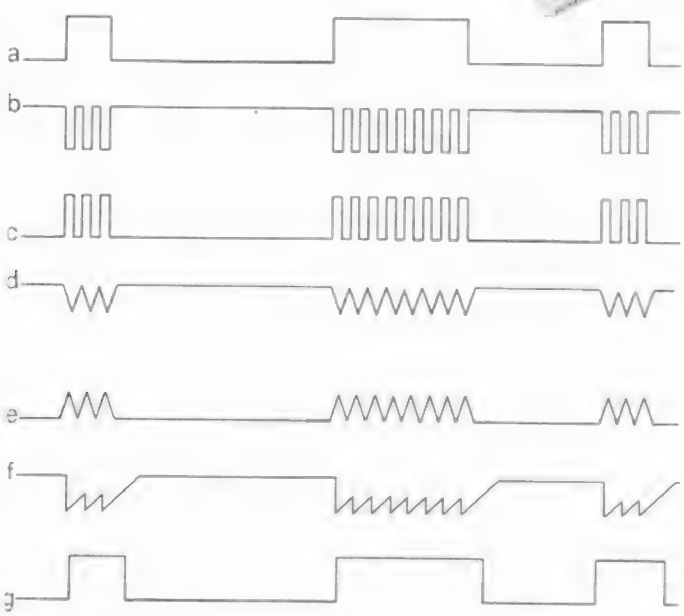


Fig.5. Voltage waveforms as found in the circuit at annotated points.

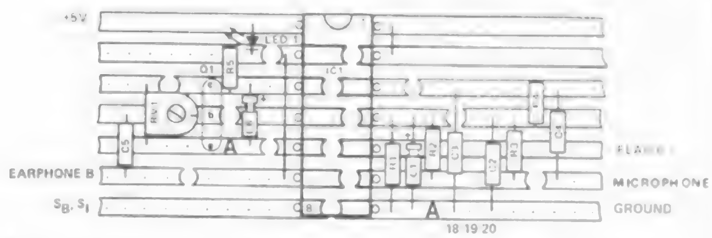


Fig.6. Veroboard layout, a larger piece will be needed if IC2 is required. Note that A must connect to A.

TRANSAM

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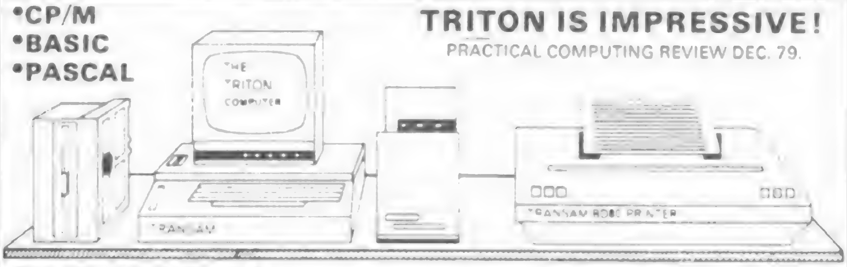

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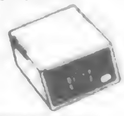

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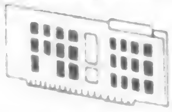

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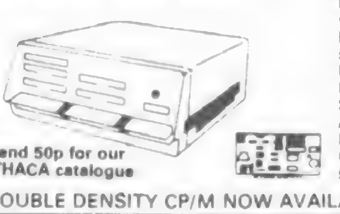

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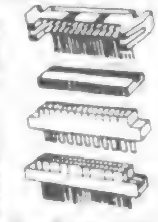

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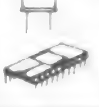

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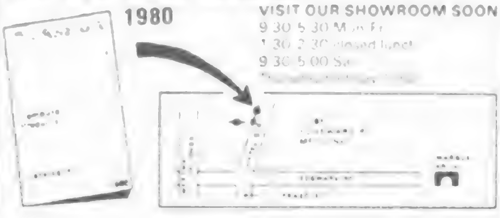

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Ian Sinclair

Further investigation into the world of data processing reveals an assortment of sorts.

Data processing, as we've said before now, is the real purpose of all but the specialised 'number-cruncher' microprocessors. This month we're going to kick-off by examining a program which is particularly important for data processing applications – a sorting program. Sorting in this context means putting into numerical order and the program arranges a given quantity of bytes into ascending order. It could be modified without too much trouble to arrange the bytes in descending order.

NBYTE	0F1D		store number
SGNL	0F1E	00	
DBYTE	0F1F	00	
RSTR	0F20	C4	
	0F21	00	
	0F22	C8	
	0F23	FB	Restore SGNL
	0F24	C0	
	0F25	F8	
	0F26	C8	
	0F27	F8	Restore DBYTE
	0F28	C4	
	0F29	50	
	0F2A	31	Restore P1
STRT	0F2B	03	SCL
	0F2C	C5	LD@P1
	0F2D	01	
	0F2E	F9	CAD
	0F2F	00	
	0F30	98	JZ to detect
	0F31	02	equality
	0F32	94	JP to
	0F33	09	XCHNG
RSTR	0F34	B8	DLD
	0F35	EA	DBYTE
	0F36	9C	examine
	0F37	F3	STRT
	0F38	C0	
	0F39	E5	SGNL
	0F3A	9C	
	0F3B	E4	RSTR
OUT	0F3C	3F	Monitor
XCHNG	0F3D	C1	Take out
	0F3E	FF	
	0F3F	01	Extension
	0F40	C1	Take out
	0F41	00	
	0F42	C9	Put back
	0F43	FF	
	0F44	01	from extension
	0F45	C9	Put back
	0F46	00	
	0F47	C4	Send
	0F48	01	to
	0F49	C8	
	0F4A	D4	SGNL
	0F4B	90	
	0F4C	E7	RSTR
	0F4D	3F	OUT

Setting up :

0FF9	0F	
0F50		onwards – numbers to be sorted.
0F1D		Number of bytes to be sorted
0F20	–	GO

Fig.1. The numerical sort program. This is a sort of the type called a "bubble-sort", in which each pair of numbers is compared in turn. A machine code sort of this type is very much faster than a similar sort operation using a computer language like BASIC.

A Sort Of A Program

This program, listed in full in Fig.1, is by far the most complex we'll meet in this series – and took longest to write! Next month we'll look at methods of developing and debugging long programs, but meanwhile let's go through the steps of this program. Addresses 0F1D to 0F1F contain quantities which are needed in the program. 0F1D must be set at the start of a run to hold the total number of bytes which are to be sorted; 0F1E and 0F1F are set to zero initially. These addresses have been labelled with names so that you can follow the various fetches, stores and jumps in the program. The program itself starts at 0F20, loading 00 and storing in 0F1E. This is a restoring operation whose purpose will be understood later. Similarly steps 0F24 to 0F27 load up the number from 0F1D and store it again at 0F1F. This may seem odd, but the reason is that 0F1F is decremented on each loop and we have to keep the original number somewhere else. We could use a load immediate for this, but this would mean having to alter a quantity inside the program to change the number of items. The last of the 'restoration' items is from 0F28 to 0F2A, and this lot restores the lower byte of P1 to 50. We're making the assumption that the list of bytes to be sorted starts at 0F50, so that pointer register P1 has been set to this address.

Now for the fun. What we're going to do is to load in two consecutive bytes, and subtract the second byte from the first. Now if the bytes are already in ascending order, this action will give a negative result, if the bytes are equal the result is zero and if the bytes are in descending order, the result is positive. Taking these out of order, if the result of the subtraction is positive, the numbers are out of order and they need to be exchanged. We can use a JP instruction here, but we have to be careful, because JP means Jump-if-positive-*or-zero*. That – or zero – bit is the catch, because if we exchange two equal bytes there's no end to the number of times we can swop the two around and the program will go into an endless loop.

At 0F2B then, we set the carry/link, because we're going to do a subtraction. At 0F2C, 0F2D we load the first byte from the table which starts at 0F50. Now we've got to remember that this will leave the pointer P1 at 0F51, because it has incremented. When we fetch the next number in the table, using the indexed complement-and-add instruction F9, the displacement number is zero – we're at address 0F51 already.

Now we have either zero, a positive number or a negative number in the accumulator. We deal with the zero problem first at 0F30, 0F31. As we've said, the zero result

means that the bytes are equal, and the 02 displacement at 0F31 lets us skip the next steps at 0F32, 0F33. That way we don't get tied into an endless loop in the next steps.

Stepping Out

Next steps? 0F32, 0F33 is a jump-if-positive step, which is *just* a jump-if-positive, since we've now eliminated the zero possibility. If we have a positive result in the accumulator, the bytes need to have their order exchanged, so the program has to jump forward to the address 0F3D labelled XCHNG. We'll look at that later. If there's no need to swop and the bytes are either in the correct order or equal, then the next step is at 0F34. Here the B8EA sequence decrements and loads from address 0F1F, because one step of sorting is complete. If the number loaded from 0F1F is not zero, the JNZ at 0F36 will cause the program to loop back to 0F2B to sort another pair of bytes, taken from 0F51 and 0F52 this time. If we've already run through all the bytes, then the byte in the accumulator at step 0F36 is zero, and the normal loop doesn't take place. Instead the program continues with a load from address 0F1E. At the start of a run, this address contains zero, but if two bytes have been exchanged, this is set to 01, indicating that the bytes are not in order. If this byte is 01, then the JNZ instruction at 0F3A returns the program to address 0F20, so that the whole sorting exercise can take place again. If there has been a complete run through without any swopping needed, then the signal byte from 0F1E is zero and the program runs through to 0F3C. This byte is 3F, so it's the end of the program.

Now how is the exchange done? The exchange part of the program starts at 0F3D and can be reached only by a jump. At 0F3D, 0F3E we have a load-to-accumulator, indexed to P1. The displacement has to be FF (−1 in decimal), because the pointer register has incremented. For example, at step 0F2C, if we had started at 0F50, the index would have incremented to 0F51. To get the first byte again, we need 0F51 − 1 which is 0F50. Simple, really! Having loaded this byte out of its memory address, we use 01 (at 0F3F) to slip it into the extension register. In our example, using the first pair of bytes 0F50, 0F51, we would now have the byte which was in 0F50 stored in the extension register. The next load, at 0F40, 0F41 takes out the byte that the pointer P1 is pointing to, in our example, the byte at 0F51. We want this byte pushed back into the first of the two addresses, 0F50 in our example. The C9FF instructions at 0F42, 0F43 do just this, with the FF ensuring that this byte is pushed back into the first address (0F50 in our example). Now at 0F44, we take back the byte which has been stored in the extension, using the 01 exchange instruction. This byte has to be stored in the second of the two addresses (0F51 in our example), so the C900 instructions take care of it, storing at the address stored in P1. Now we have to set the signal. The load immediate at 0F47 puts 01 in the accumulator, and C8D4 transfers this byte to address 0F1E, to act as a signal at step 0F38. With the exchange completed, we can jump back to address 0F20 to start another run of the sort.

Sorting It Out

That's the program. The set up operation is to dial up 0FF9 and set the byte to 0F, then abort to set the bytes to be sorted from 0F50 onwards. Another abort, this time to 0F1D, and the number of bytes can be keyed in and three 'Mem' steps will take us to 0F20 where the program can start. At the end of the sort, the display will show address 0F3D – and you should know why by now!

Try it out after switching on, simply using the 'garbage' as data, and you'll see the number of bytes which you have specified (at 0F1D) put into order.

A Touch Of Python!

Now for something completely different. Many applications of the 8060 are in control, so that control outputs are needed. Most MPU's need another chip, an I/O port, for this job. The I/O port is connected to the data and address buses, and can give various outputs or inputs when addressed like memory. A port is available for the 8060; it's the INS8154, which is an optional extra for the Mk 14. For a surprising number of applications, though, the built-in features of the 8060 make any such additions unnecessary.

What are these built-in features? For one thing, there are the three 'USER FLAGS', at pins 19, 21 and 22 on the MPU and on lines 30, 32, 31 (in that order) on the top edge connector of the Mk 14. Each of these can be set (1) or reset (0) under program instruction and is latched, so that it'll stay set, or reset, as instructed while the program moves on to something else. Just using these as they are gives you three outputs, but for more you only need a binary-to-octal decoder, such as the 8250 (Signetics), which converts binary signals on three lines to eight separate outputs. That way you can have Flag 0 giving an output on line 0, F1 an output on line 1, F0 and F1 an output on line 3 and so on up to line 7. If you happen to have a 7445 BCD to decimal decoder handy, you can use that by connecting the D input (pin 12) low and using outputs 0 to 7 only (pins 1 to 7, and 9). We're just going to taste what can be done by attaching LED's to these outputs. Solder wires to the edge connection at positions 30, 32, 31 and connect the ends to LED's with limiting resistors of around 2k2. I used the ever-handy Eurobreadboard for this and other ideas described next month. Make sure you know which LED is controlled by which flag.

BACK	0F20	C4	LDI
	0F21	01	
	0F22	07	CAS
	0F23	90	JMP
	0F24	FB	BACK

Fig.2. The Flag outputs – using LEDs to detect the outputs, the program shows how the flags can be set.

This done, try the program in Fig.2. Not much to it – it loads 01, transfers the 01 to the status register, then loops back. What happens when you run it? That's right, LED 0 comes on and the display goes out. Why does the display go out? Because we're running an endless loop, with nothing to display (to get out, press 'Reset'). Why are we running an endless loop? Good question – we don't need to, thanks to the latching of the flag outputs. We can, therefore, use the even shorter program in Fig.3, which ends with 3F after the CAS (07) instruction. The LED remains lit and the display shows the start of the monitor program. Now if we alter the program, placing 02 or 04 at address 0F21, we can light one of the other LEDs. If we use numbers like 03, 05, 06, 07 we can light combinations of LED's. To put them out, reset, or run the program again with 00 loaded in at address 0F21.

START	0F20	C4	LDI
	0F21	01	
	0F22	07	
	0F23	3F	OUT

Fig.3. Because the flags are latched, this even shorter program can be used.

A Flash Of Inspiration

Next item – flashing an LED. To flash any of the flag LED's, we need to latch it on, wait for some time, turn it off, wait again and then repeat. The delays have to be built in because of the fast clock speed; if we didn't build in a long enough delay we wouldn't be able to see the flashing. Incidentally, using shorter delays gives audio outputs at the flags, and with three flags you could have a melody and two harmonies – very tempting, though difficult to write, and a definite step up from your monophonic door bell.

We digress. Fig.4 shows a flashing LED program. The LED that is flashed is selected by the step at 0F21, so that for other LED's or combinations of LED's you need a different number here. The sequence is simple. We load in 01 (or whatever) and CAS (07) to turn the LED on, delay for as long as possible by loading FF and delaying (8F) for the maximum count of FF as well and then turn off by loading 00 and exchanging. Another delay is then needed (or you won't see any flash) and then the program loops back to the start. Because it's an endless loop, the display goes out and you'll need to press RESET to get out of it.

Now we could run a sequence of lights by having a long program consisting of selecting the light, turning on, delaying, turning off, selecting the next one, and so on, but this sort of thing looks more of an application for a table.

LOAD	0F20	C4	
	0F21	01	Any other LED or combination of LEDs can be chosen by altering the number used at 0F21
	0F22	07	
	0F23	C4	
	0F24	FF	
	0F25	8F	
	0F26	FF	
	0F27	C4	
	0F28	00	
	0F29	07	
	0F2A	C4	
	0F2B	FF	
	0F2C	8F	
	0F2D	FF	
	0F2E	90	
	0F2F	F0	

Fig.4. A simple program for flashing an LED on and off.

It's also an application for a technique we haven't used so far – a subroutine. Fig.5 shows a program for lighting the LED's in sequence, extinguishing each one as the next one is switched on. The main part of the program is reasonably straightforward, but you have to know what the thinking behind it is to follow it through. All the steps from 0F15 to 0F20 are concerned with loading starting addresses into pointer registers P1 and P2. The address for P1 is 0F40 and the address for P2 is 0F50. Both of these addresses are within reach of a program relative jump, but we need one for an auto-indexed table and we're using the other for a subroutine because we want to. The subroutine is called only once on each loop, and from the same place, so we could equally well have used JMP instructions, but this is a good opportunity to try out a subroutine.

P1 is being used as a table pointer, then, and P2 for the subroutine. It's more usual in 8060 systems to use P3 for subroutines, but P3 is used so extensively by the monitor that it's best left alone unless you like living dangerously.

At 0F21, we set up a counter for the number of lights we want to flash in sequence. We've chosen three, but if you want various combinations of lights to come on and off you will need greater numbers here. This number is then

RELOAD	0F15	C4	Load
	0F16	0F	Registers
	0F17	35	
	0F18	C4	
	0F19	0F	
	0F1A	36	
	0F1B	C4	
	0F1C	40	
	0F1D	31	
	0F1E	C4	
	0F1F	50	
	0F20	32	
	0F21	C4	
	0F22	03	
LOAD	0F23	C8	
	0F24	0F	LAMPS
START	0F25	C5	
ON	0F26	01	
	0F27	07	
	0F28	3E	
	0F29	C4	
OFF	0F2A	00	
	0F2B	07	
	0F2C	B8	DLD
	0F2D	06	LAMPS
	0F2E	9C	
	0F2F	F5	START
	0F30	90	
	0F31	E3	RELOAD
	0F32	3F	OUT
LAMPS	0F40	01	
	0F41	02	
	0F42	04	
	0F43	3F	
	0F50	3E	
	0F51	C4	
	0F52	FF	
	0F53	8F	
	0F54	FF	
	0F55	90	
	0F56	F9	

Fig.5. An elementary "traffic-light" program.

stored (steps 0F23, 0F24) into address 0F33, from which it will be fetched and decremented on each loop. The flashing starts at 0F25. At 0F25, the auto-indexed load instruction takes the first byte from the table (at 0F40), puts it in the register and increments the pointer address (to 0F41). As usual, this byte, the lamp number, is exchanged into the status register so that the LED comes on. At 0F28, the instruction is 3E, meaning exchange program counter with pointer 2. Now the address which is loaded into pointer 2 is 0F50, so the exchange puts the program counter to 0F50 and stores 0F28 in P2. The counter then increments, as it always does at the end of an instruction, and the next program step is at 0F51. This is the start of the delay subroutine, using the familiar steps. At the end of the delay, there's a jump-back-to-0F50 instruction. What does that do? At 0F50, the instruction is 3E, the exchange code. Exchanging now means that the address in P2, which has been 0F28 since we previously exchanged, goes back into the program counter and 0F50 (the address to which we jumped at the end of the delay) goes back into P2, restoring it to what it was. The program counter then increments and the next instruction comes from 0F29. Notice that the exchange instruction 3E had to be at the start of the subroutine so that the correct address could be loaded back – if we put it at

0F50	3E
0F51	C4
0F52	FF
0F53	8F
0F54	FF
0F55	C4
0F56	FF
0F57	8F
0F58	FF
0F59	90
0F5A	F5

Fig.6. One method of obtaining longer delays.

0F55 that's where the next subroutine would land up; not so useful!

At 0F29 to 0F2B we switch the LED off, and then steps 0F2C to 0F2F select the next lamp, decrementing the lamp count and looping back. When all the lamps have been lit in sequence, we get to 0F30, which puts us back to 0F15, reloading the registers.

One of the advantages of this scheme is that it lets us play around with different sequences and delays. You can get whatever sequence you want by using a longer table, with the correct number of bytes loaded in at 0F22. You can get different delays by modifying the subroutine shown in Fig.6. This uses two lots of delays, so that the ON part of each lamp is longer. Not enough? Then try the subroutine shown in Fig.7. This loads a timing byte, entered at 0F53 into store at 0F51. The usual delay follows, but at the end of the delay, the timing byte is decremented, and the number tested at 0F5C. If the byte is not zero, the delay is repeated and only when all the repeats are finished does the subroutine go back to the entry point. We've used 0A at 0F53 to determine the delay; long delays are possible with this scheme.

IN	0F50	3E	
STORE	0F51	00	
	0F52	C4	
TIME	0F53	0A	
	0F54	C8	
	0F55	FC	to store
DLY	0F56	C4	
	0F57	FF	
	0F58	8F	
	0F59	FF	
	0F5A	B8	
	0F5B	F6	
	0F5C	9C	back to
	0F5D	F8	DELY
	0F5E	90	back to
	0F5F	F0	IN

The byte at 0F53 determines the total time for each light.

Fig.7. A better method which enables the delay time to be more easily controlled.

If Music Be Microed. . . . . .

Music generators use a more complicated scheme, because two delays are needed, one for on and one for off. The delay has to be taken from a table, because delay decides frequency and you wouldn't want a tune with just one note. The number of times you loop round an on-off flag program determines the duration of a note and this is taken also from a table which loads a counter.

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